HOTWIRE™ DSLAM FOR 8540 AND 8546 DSL CARDS

NETWORK CONFIGURATION GUIDE

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PARADYNE™

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About This Guide

Document Purpose and Intended Audience

This guide describes the Hotwire Digital Subscriber Line Access Multiplexer (DSLAM), its internetworking features, and how it supports the Hotwire 8540 and 8546 Digital Subscriber Line (DSL) cards. It also provides information on what you need to know before planning your network. Use this guide to:

- Obtain a basic understanding of the Hotwire DSLAM
- Understand how the DSLAM operates within the network
- Understand the network model, management domain, and service domain
- Understand how to allocate Internet Protocol (IP) addresses
- Understand dynamic IP addressing

NOTE:

The *DSL Sourcebook*, written by Paradyne Corporation, is about DSL technology and opportunities. Read the *DSL Sourcebook* for the what, how, and why of DSL-based service deployment. The book is available by calling 1-800-PARADYNE.

This guide is intended for network planners, network administrators, and network maintainers. It is assumed that you have a basic understanding of internetworking protocols and their features. Specifically, you should have a basic familiarity with Simple Network Management Protocol (SNMP), Network Management Systems (NMSs), and the following internetworking concepts:

- TCP/IP applications
- IP and subnet addressing
- IP routing (also referred to as IP forwarding)

Document Summary

Section	Description
Chapter 1	*Introduction to the Hotwire DSLAM.* Provides an overview of the Hotwire DSLAM and its components. It also briefly describes the network model and the domain types.
Chapter 2	*Service Domain Features.* Describes the features that are supported in the service domain.
Chapter 3	*Management Domain Features.* Describes the features that are supported in the management domain.
Chapter 4	*Components of the Network Model.* Describes the components of the service and management domains. These domains comprise the network model.
Chapter 5	*IP Address Allocation.* Describes the IP address allocation schemes for the components that make up the network model. With these allocation schemes, IP addresses can be assigned statically or dynamically. It also describes the naming convention used for the Hotwire DSLAM system ports.
Chapter 6	*IP Routing.* Provides information and examples of destination-based routing (static and dynamic routes) and source-based routing.
Chapter 7	*IP Filtering.* Describes IP filtering advantages and scenarios.
Chapter 8	*SNMP Agent.* Describes the SNMP agent configuration (community configuration and trap configuration).
Chapter 9	*Packet Walk-Throughs.* Provides examples of how data packets are routed through the service and management domains.
Appendix A	*Network Configuration Worksheets.* Provides worksheets to record your configuration settings.
Appendix B	*IP Filtering Configuration Worksheets.* Provides worksheets to help you define a filter for a specific interface on an MCC or DSL card.
Appendix C	*SNMP Configuration Worksheets.* Provides worksheets to help you set up community names and enable/disable the generation of alarms.
Glossary	Defines acronyms and terms used in this document.
Index	Lists key terms, acronyms, concepts, and sections in alphabetical order.

Product-Related Documents

Document Number	Document Title
5020-A2-GN10	*Hotwire 5020 POTS Splitter Central Office Installation Instructions*
5030-A2-GN10	*Hotwire 5030 POTS Splitter Customer Premises Installation Instructions*
5034-A2-GN10	*Hotwire 5034 Indoor POTS Splitter Customer Premises Installation Instructions*
5100-A2-GB21	*Hotwire 5171 Remote PC Network Interface Card User's Guide*
5100-A2-GB22	*Hotwire 5170 Remote Termination Unit User's Guide*
5216-A2-GN10	*Hotwire 5216 Remote Termination Unit (RTU) Customer Premises Installation Instructions*
5246-A2-GN10	*Hotwire 5246 Remote Termination Unit (RTU) Customer Premises Installation Instructions*
5446-A2-GN10	*Hotwire 5446 Remote Termination Unit (RTU) Customer Premises Installation Instructions*
5546-A2-GN10	*Hotwire 5546 Remote Termination Unit (RTU) Customer Premises Installation Instructions*
7700-A2-GB23	*OpenLane DCE Manager for HP OpenView for Windows User's Guide*
7800-A2-GB26	*OpenLane DCE Manager User's Guide*
8000-A2-GB20	*Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*
8000-A2-GB24	*Hotwire DSLAM Configuration for 8540 and 8546 DSL Cards Startup Instructions*
8000-A2-GB25	*Hotwire 8100/8200 Interworking Packet Concentrator (IPC) Network Configuration Guide*
8000-A2-GB29	*Hotwire Management Communications Controller (MCC) Card User's Guide*
8000-A2-GB90	*Hotwire 8100/8200 Interworking Packet Concentrator (IPC) User's Guide*
8000-A2-GN11	*Hotwire Management Communications Controller (MCC) Card Installation Instructions*
8540-A2-GN10	*Hotwire 8540 Digital Subscriber Line (DSL) Card Installation Instructions*
8546-A2-GN10	*Hotwire 8546 Digital Subscriber Line (DSL) Card Installation Instructions*

Document Number	Document Title
8600-A2-GN20	*Hotwire 8600 Digital Subscriber Line Access Multiplexer (DSLAM) Installation Guide*
8800-A2-GN21	*Hotwire 8800 Digital Subscriber Line Access Multiplexer (DSLAM) Installation Guide*

Contact your sales or service representative to order additional product documentation.

Paradyne documents are also available on the World Wide Web at:

http://www.paradyne.com

Select *Service & Support* → *Technical Manuals*

Introduction to the Hotwire DSLAM

1

What is the Hotwire DSLAM?

The Hotwire™ Digital Subscriber Line Access Multiplexer (DSLAM) is a multiservices DSL platform that provides high-speed Internet or Intranet access over traditional twisted-pair telephone wiring. The DSLAM chassis houses DSL cards that interoperate with multiple types of Hotwire Remote Termination Units (RTU) to deliver applications at multimegabit speeds in support of packet services over a Digital Subscriber Line (DSL) link.

High-speed service traffic types from the DSL links are groomed and then concentrated for efficient forwarding to backbone routers. By enabling very high speeds using DSL technology and then concentrating Internet Protocol (IP) traffic, greater performance is realized. Backbone service nodes can be placed deeper into the network, dramatically improving the economics of service provisioning while taking advantage of the substantial speed increases of DSL.

When used in combination with a Hotwire 8200 Interworking Packet Concentrator (IPC), the Hotwire DSLAM provides high-speed IP service concentration over a wide array of Local Area Network (LAN) architectures as well as an Asynchronous Transfer Mode (ATM) interface to Wide Area Networks (WANs).

In addition, the Hotwire DSLAM with a Hotwire RTU can be multiplexed with Plain Old Telephone Service (POTS) over the same copper line providing simultaneous usage of POTS and digital applications to separate locations. That is, the optional POTS splitters allow simultaneous voice and data connections over a standard telephone line.

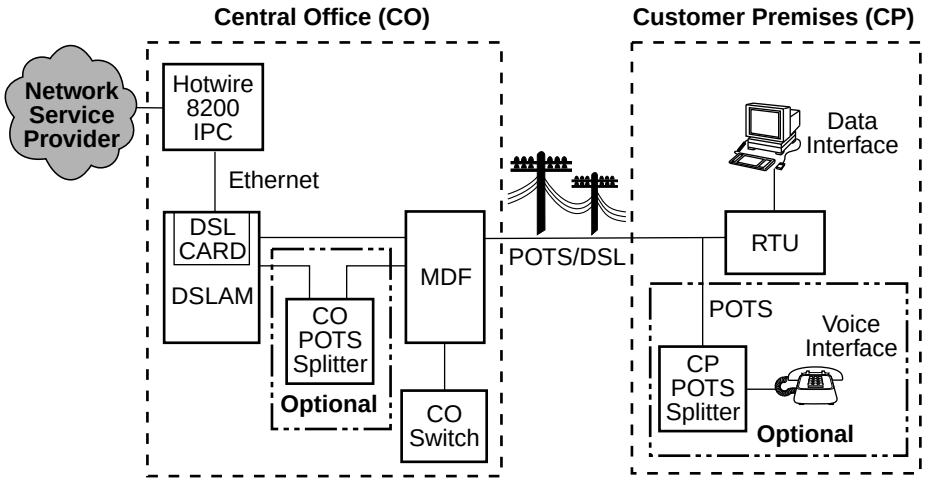
NOTE:

If you would like more information on DSL-based services, applications, and network deployment, refer to Paradyne's *DSL Sourcebook.* The book may be ordered by calling 1-800-PARADYNE.

The following illustration shows a high-level view of a Hotwire configuration:

NOTE:

The cable connection from a DSL card to a Main Distribution Frame (MDF) can either be a direct connection to the MDF or a connection through a POTS splitter to an MDF, but not both. Refer to the appropriate Hotwire DSLAM Installation Guide for more information.



Legend: DSL - Digital Subscriber Line RTU - Remote Termination Unit
MDF - Main Distribution Frame POTS - Plain Old Telephone Service
IPC - Interworking Packet Concentrator

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The Hotwire DSLAM can be configured to work with multiple types of RTUs installed at the customer end of the local telephone loop. RTUs terminate the DSL line and allow users at remote locations to access Network Service Providers (NSPs) or corporate networks by means of the DSL phone line.

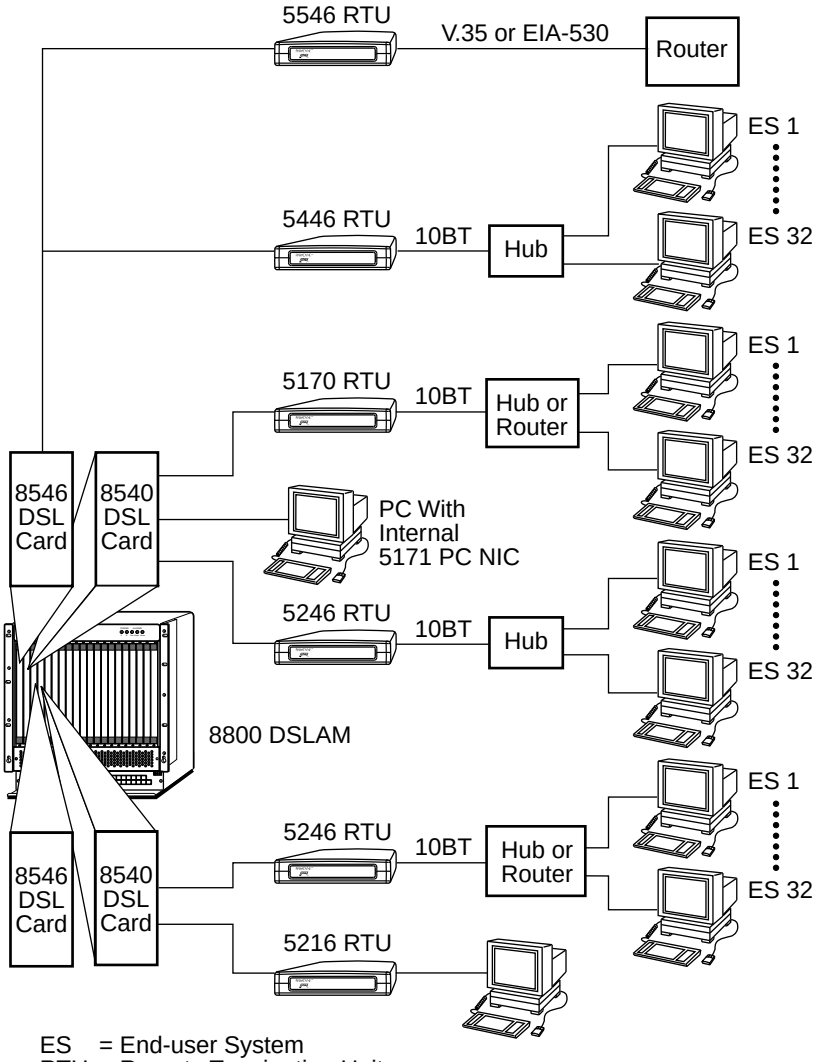
When using an 8540 DSL card in the DSLAM, the DSLAM can be configured to interoperate with any one of the following RADSL RTUs on each of its four DSL ports:

- 5170 RTU – Operates at speeds up to 7 Mbps with a simple bridge that supports up to 32 end-user systems.
- 5171 Remote PC Network Interface Card (NIC) – Operates at speeds up to 2.5 Mbps supporting a single user's PC.
- 5216 RTU – Operates at speeds up to 1.28 Mbps supporting a single user.
- 5246 RTU – Operates at speeds up to 7 Mbps with a transparent learning bridge that supports up to 32 end-user systems.

When using an 8546 DSL card with the 5446 RTU in the DSLAM, the DSLAM can be configured to interoperate with up to four 5446 RTUs. The 5446 RTU operates as an IP forwarder at speeds up to 7 Mbps. This RTU supports up to 32 end-user systems with individual IP addresses or subnets.

When using an 8546 DSL card with the 5546 RTU in the DSLAM, the DSLAM can be configured to allow an end-user to utilize an external router with a V.35/EIA-530 interface. The 5546 RTU operates at speeds up to 7 Mbps supporting up to 32 hosts or subnets behind the external router connected to the 5546 RTU. As most serial interface speeds are set at the T1/E1 rate, the 5546 operational speed should be set accordingly.

The following illustration shows a Hotwire network configuration from the 8800 DSLAM to multiple RTUs. (Stacked 8600 DSLAMs can also be used in place of an 8800 DSLAM.)



Hotwire DSLAM Components

The Hotwire DSLAM resides in a central office (CO) or wire center. It consists of the following components:

- Hotwire DSLAM chassis
- MCC card
- DSL cards

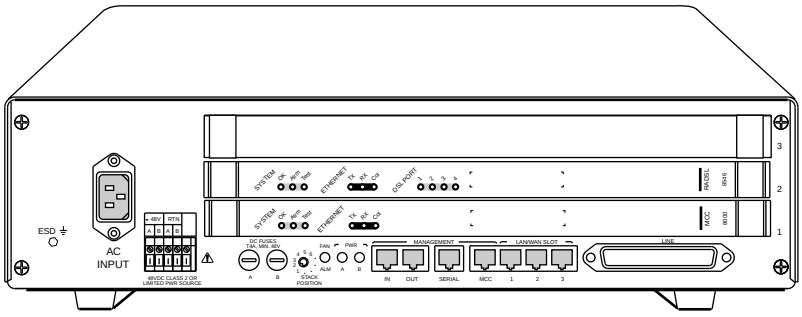
In addition, optional POTS splitters can be installed at the CO. For information about a CO POTS Splitter, see the *Hotwire 5020 POTS Splitter Central Office Installation Instructions*.

Hotwire DSLAM Chassis

There are two types of chassis:

- **Hotwire 8600 DSLAM chassis**

  The Hotwire 8600 DSLAM is a low-cost alternative to the Hotwire 8800 DSLAM. The 8600 DSLAM is an independent, standalone system. A stackable design provides for up to six 8600 DSLAMs to share management access through a single MCC card. In a stacked configuration, the first or base chassis is equipped with an MCC card in Slot 1, leaving Slots 2 and 3 available for up to two DSL cards with a maximum of eight DSL ports. Each additional chassis houses up to three DSL cards. This stacking capability allows you to incrementally expand your DSL access service.



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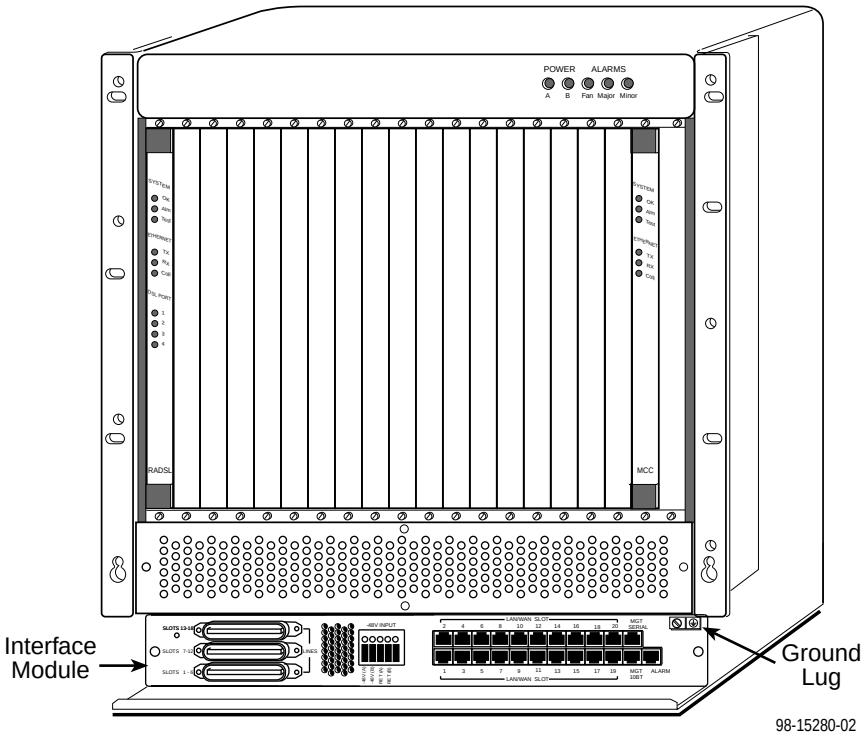
For more information about the Hotwire 8600 DSLAM chassis, see the *Hotwire 8600 Digital Subscriber Line Access Multiplexer (DSLAM) Installation Guide*.

- **Hotwire 8800 DSLAM chassis**

  The Hotwire 8800 DSLAM is a 20-slot chassis designed to house up to 18 DSL cards and one MCC card. (The remaining slot is reserved for future use.) The Hotwire 8800 DSLAM chassis requires one MCC card and at least one DSL card.



For information about the Hotwire 8800 DSLAM chassis, see the *Hotwire 8800 Digital Subscriber Line Access Multiplexer (DSLAM) Installation Guide*.

MCC Card

The MCC card is a single resource in the Hotwire DSLAM that provides consolidated management access for the DSL cards and the Hotwire RTU from any one of the following:

- SNMP management systems, such as HP OpenView with Paradyne's OpenLane™ DCE Manager (via the MCC card's Ethernet port),
- Remote telnet sessions (via the MCC card's Ethernet port),
- Local asynchronous terminal (via the MCC card's VT100 serial port), or
- Remote asynchronous terminal connected to a modem (via the MCC card's serial port).

The MCC card performs alarm monitoring of the Hotwire DSL cards, the DSLAM power and cooling systems, and interfaces to the CO alarm system. It also interfaces with external managers and servers (e.g., Trivial File Transfer Protocol servers) for system configuration and management.

DSL Cards

Each 8540 or 8546 DSL card in the Hotwire DSLAM chassis contains four DSL ports with on-board IP packet forwarding functionality. The outputs of the four DSL ports are combined onto one 10BaseT interface for connecting to the Internet or Intranet by means of the Network Access Provider's network.

For a list of the supported features of the 8540 and 8546 DSL cards, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

What is an RTU?

A Hotwire Remote Termination Unit (RTU) resides at the customer premises. The RTU connects to the local loop to provide high-speed connectivity to the Hotwire DSLAM. In addition, the RTU and your telephone can function simultaneously over the same pair of copper wires when a POTS splitter is used at both ends of the local loop. The POTS splitter filters out the DSL signal and allows the POTS frequencies to pass through.

If you have an . . .	Your DSL card interoperates with a . . .
8540 DSL Card	5170 RTU
	5171 Remote PC NIC
	5216 RTU
	5246 RTU
8546 DSL Card	5446 RTU
	5546 RTU

The following sections describe these RTUs.

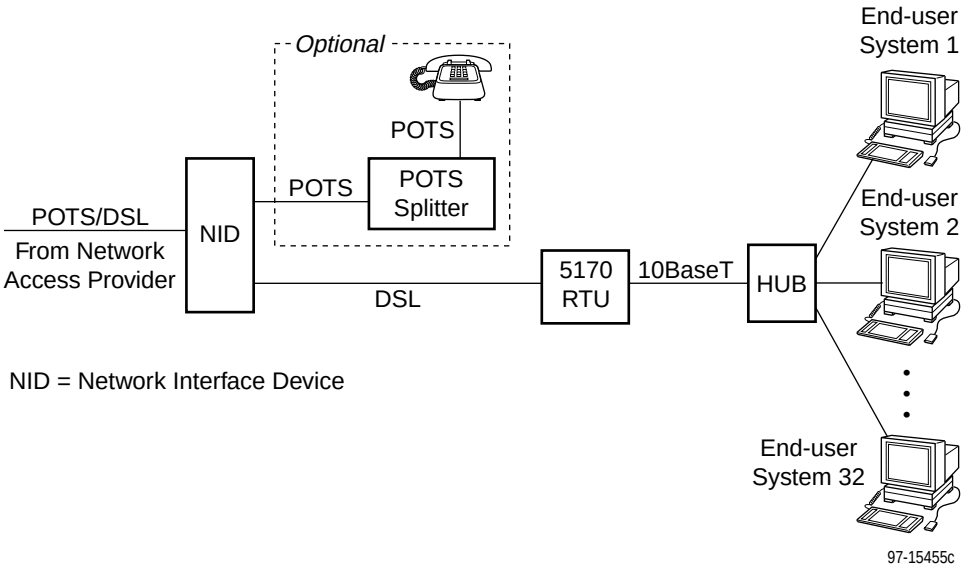
5170 RTU

The Hotwire 5170 RTU is a standalone unit designed for the home-office users with a LAN. The RTU communicates with any computer equipment or router using its Ethernet network interface card (NIC).

Control of the 5170 RTU is supplied by a windows-based diagnostics utility which enables users to check RTU status, network transmission status, and run diagnostic tests.

You can connect the 5170 RTU directly to your PC using an 8-pin modular Ethernet cable.

The following illustration shows the Hotwire 5170 RTU with its 10BaseT interface connected to multiple end-user systems (typically a PC with a LAN card).

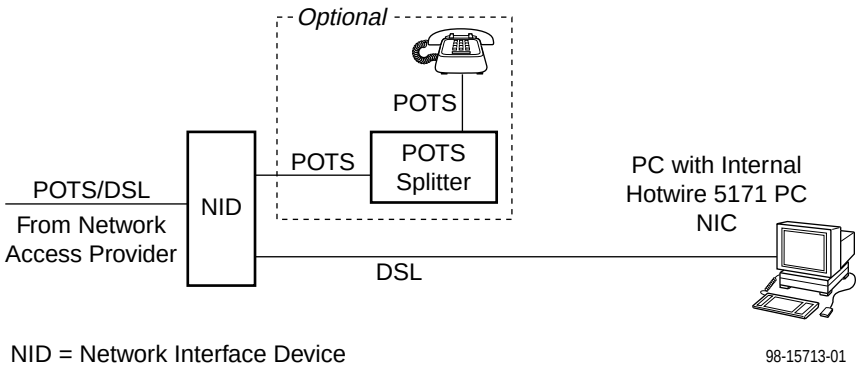


For more information about the Hotwire 5170 RTU, see the *Hotwire 5170 Remote Termination Unit User's Guide*.

5171 Remote PC NIC

The Hotwire 5171 PC Network Interface Card (NIC) is a 16-bit ISA, add-on card with a 6-pin telephone modular jack connector used for the DSL network connection. The 5171 PC NIC edge connector plugs into a 16-bit expansion slot in an IBM-compatible 80486 (or higher) system board and conforms to ISA bus standards.

The following illustration shows a PC with an internal Hotwire 5171 PC NIC.



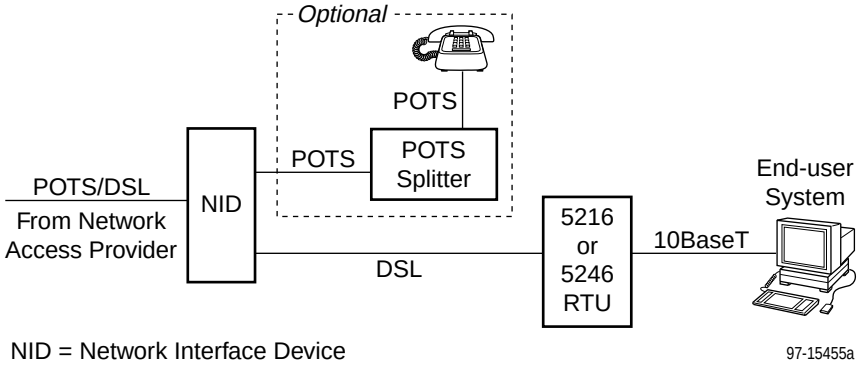
For more information about the Hotwire 5171 Remote PC NIC, see the *Hotwire 5171 Remote PC Network Interface Card User's Guide*.

5216 and 5246 RTUs

The Hotwire 5216 and 5246 RTUs are each composed of a DSL modem and a bridge.

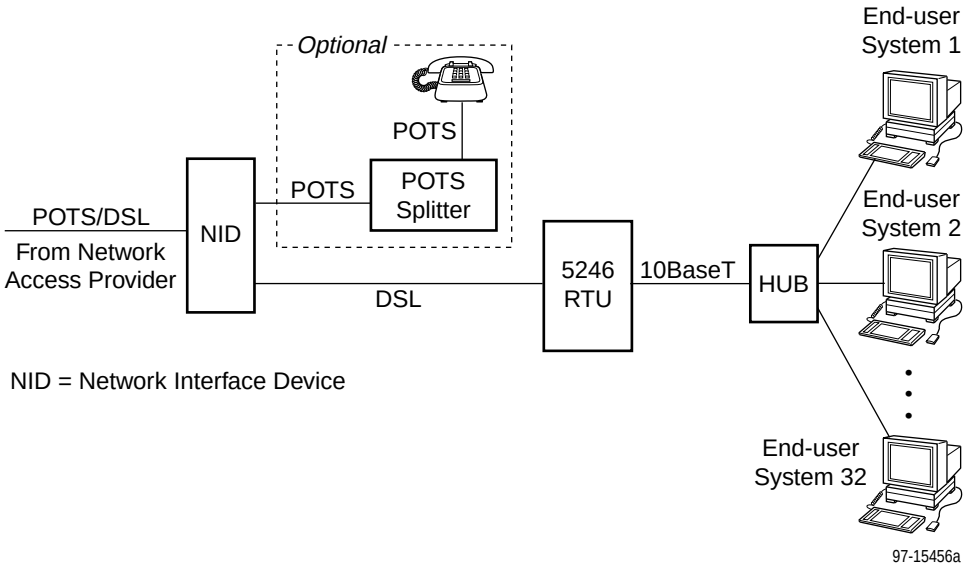
The Hotwire 5216 RTU is designed for home office/residential applications and supports a single end user system. The 5216 RTU supports limited DSL line rates.

The following illustration shows the Hotwire 5216 RTU with its 10BaseT interface connected directly to an end-user system (typically a PC or workstation with a LAN card).



The Hotwire 5246 RTU is designed for small office or home office (SOHO) applications and supports up to 32 end-user systems with a LAN. The Hotwire 5246 supports full speed DSL line rates and filters local LAN traffic from traversing the DSL link by incorporating learning bridge functionality.

The following illustration shows the 5246 RTU with its 10BaseT interface connected to multiple end-user systems (typically a PC or workstation with a LAN card) via an Ethernet 10BaseT hub.



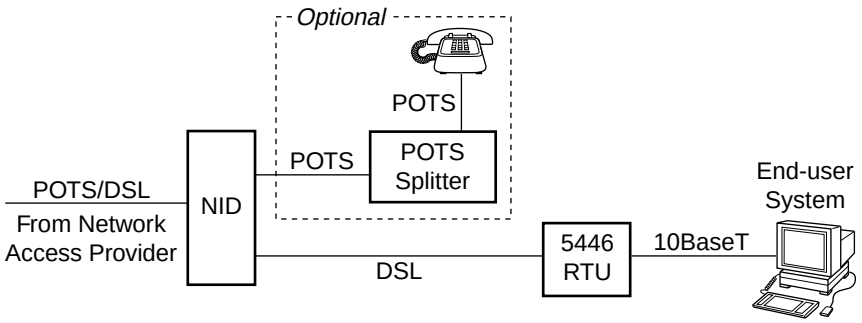
For more information about these RTUs, see the *Hotwire 5216 Remote Termination Unit (RTU) Customer Premises Installation Instructions* and the *Hotwire 5246 Remote Termination Unit (RTU) Customer Premises Installation Instructions*.

5446 RTU

The Hotwire 5446 RTU is composed of a DSL modem supporting full speed DSL line rates and an IP forwarder that can support multiple end-user systems.

The 5446 RTU can be connected directly to an end-user system or to multiple end-user systems via an Ethernet (10BaseT) hub.

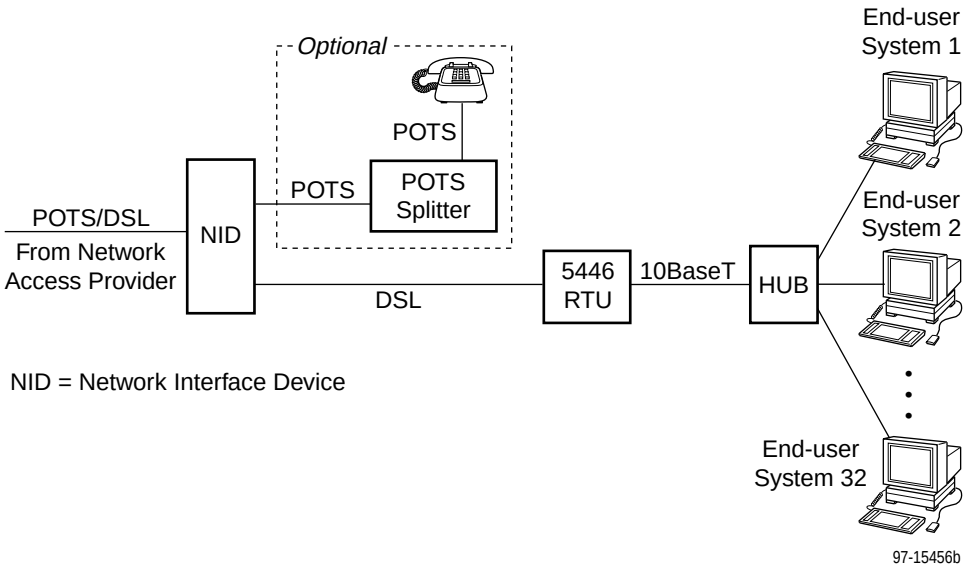
The following illustration shows the Hotwire 5446 RTU with its 10BaseT interface connected directly to an end-user system (typically a PC or workstation with a LAN card) with a crossover cable:



A 5446 RTU supports multiple service domains and can be configured with up to four IP subnets. Each of the four IP subnets can be comprised of multiple users by appropriately sizing the respective IP subnet.

In addition, each 5446 RTU supports up to 32 end-user systems that dynamically acquire their IP addresses or have static IP addresses. The Dynamic Host Configuration Protocol (DHCP) is used for dynamic addressing. In both cases (dynamic and static), these 32 end-user systems must be in one of the configured IP subnets.

The following illustration shows a Hotwire 5446 RTU with its10BaseT interface connected to multiple end-user systems (typically a PC or workstation with a LAN card) via an Ethernet (10BaseT) hub.

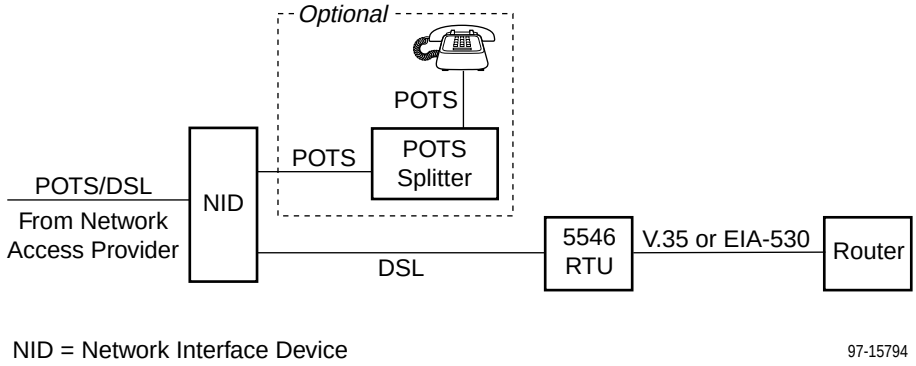


For more information about the 5446 RTU, see the *Hotwire 5446 Remote Termination Unit (RTU) Customer Premises Installation Instructions*.

5546 RTU

The Hotwire 5546 RTU is composed of a DSL modem port and a frame forwarder that connects to an end-user router with a V.35/EIA-530 interface using PPP protocol.

The 5546 RTU does not need an IP address, so therefore an IP address is not injected. In addition, up to 32 hosts or subnets behind the external router can be connected. The 5546 may be configured via a VT-100 console connected to the RTU console port.



Data Rates

The Hotwire DSL card employs Rate Adaptive Digital Subscriber Line (RADSL) devices based on Carrierless Amplitude & Phase (CAP) technology. The RADSL speed is asymmetric. This means that the downstream rate (from the DSLAM to the RTU) is faster than the upstream rate (from the RTU to the DSLAM).

You can manually set the speed (providing the line you are using can support the specified speed) or set the mode to rate adaptive. When the mode is set to rate adaptive, the Hotwire DSLAM determines the line speed during the initial handshaking session between the DSLAM and the RTU based on the local loop length, the amount of noise on the loop, and the user-configurable upper and lower speed limits.

The following are the maximum upstream and downstream data rates:

- Maximum upstream data rate: 1088 kbps (1.088 Mbps)
- Maximum downstream data rate: 7168 kbps (7.168 Mbps)

Data rates and data transmission distances vary depending on existing telephone line conditions (i.e., the DSL cards measure performance during operation and can adjust the upstream or downstream rate to match changing local loop characteristics because of temperature, humidity, or electrical interference). Also, the maximum data rate will be dependent on the RTU in use.

For a complete listing of the DSL card data rates and information on how to set the line speed, see Chapter 5, *DSL Card Configuration*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Overview of the Hotwire DSLAM Network Model

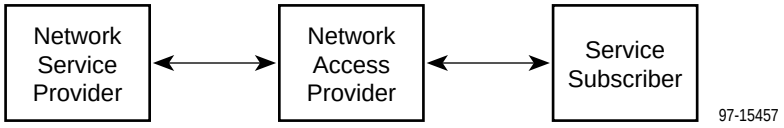
The Hotwire DSLAM and the Hotwire RTUs provide high-speed connectivity to the Internet, corporation, or other network service from the end-user system.

The Hotwire DSLAM network model can be implemented in a number of ways. For example:

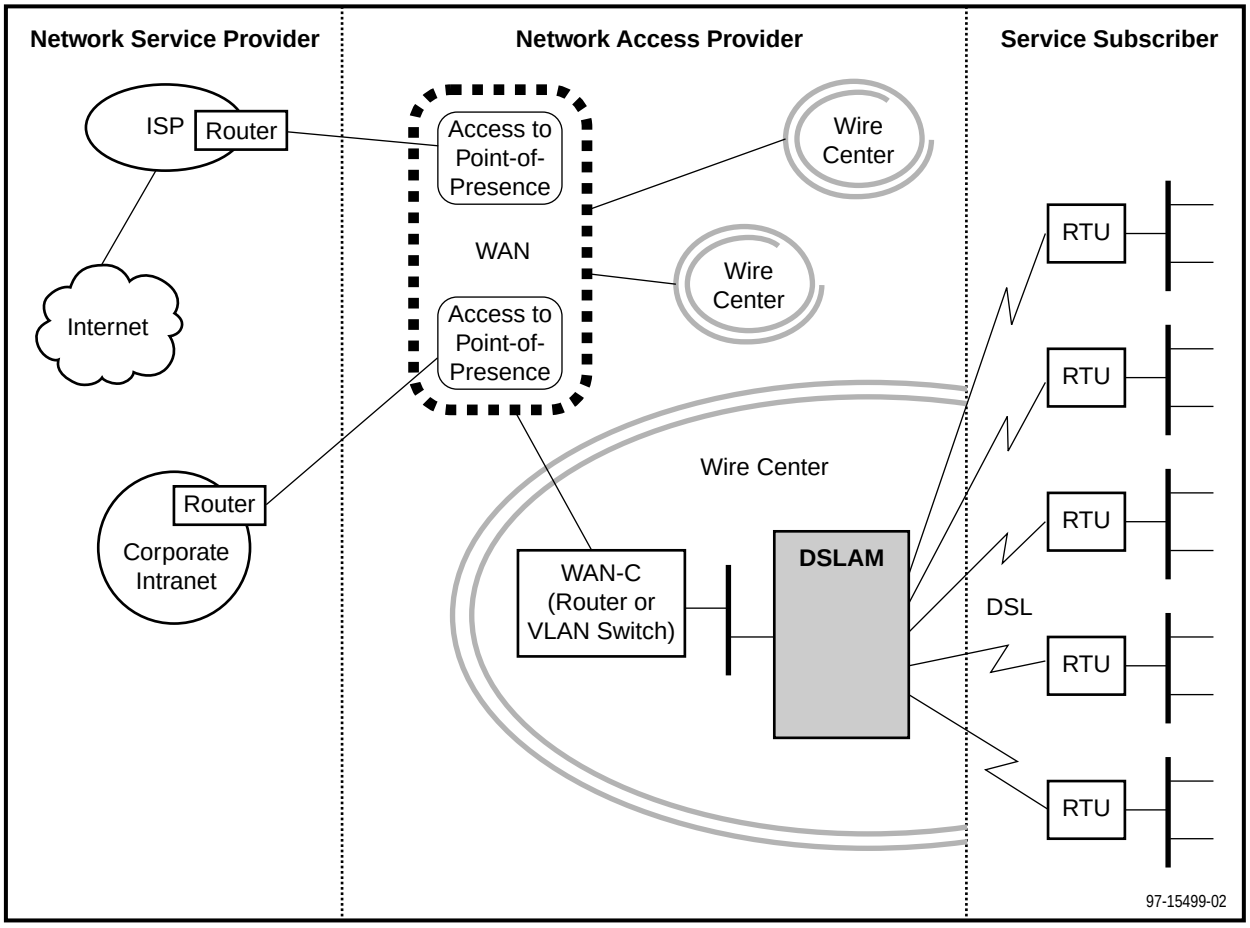
- A Small Office/Home Office (SOHO) implementation with one or more users connected to a LAN needing high-speed connectivity to an Internet Service Provider (ISP).
- A SOHO implementation with one or more users connected to a LAN needing high-speed connectivity to the corporate LAN or Intranet.
- A campus implementation needing internetworking between several sites, each with a LAN.

The network model for these examples can be partitioned into the following building blocks:

- **Network Service Provider (NSP)**
- **Network Access Provider (NAP)**
- **Service Subscriber**



The following illustration shows a detailed view of the network model:



- The **Service Subscriber** is the user (or set of users) that has contracted to receive networking services (e.g., Internet access, remote LAN access) for the end-user system from one or more Network Service Providers (NSPs). Service Subscribers may be:

  — Residential users connected to public network services (e.g., the Internet)

  — Work-at-home users connected to their corporate Intranet LAN

  — Commercial users at corporate locations (e.g., branch offices) connected by a LAN to other corporate locations or connected to public network services

  RTUs must be installed at the customer premises to provide the Service Subscriber access by way of DSL to any of the above services.

- The **Network Access Provider** (NAP) is typically the network provider (e.g., a Regional Bell Operating Company, an Alternate Local Exchange Carrier) that has access to the copper twisted pairs over which the DSL-based service operate. The NAP provides a transit network service permitting connection of service subscribers to NSPs.

  Typically, the NAP network is organized into three components:

  — **Wire center**

  The wire center is usually a local serving office where the wiring from the service subscribers is terminated on the Hotwire DSLAM. This could be a CO.

  — **Wide Area Network (WAN)**

  The WAN concentrates and switches data traffic from multiple wire centers to one or more Regional Centers where service providers have access to the network.

  — **Regional center**

  The NSP's Point-of-Presence (POP) is the access point to the NAP network for an NSP and is located at the regional center. The connection from the NAP to the NSP network is typically across a WAN connection to the NSP router at the regional center. This router acts as a next-hop location to the NSP's network.

- The **Network Service Providers** (NSPs) can be either public access providers to the Internet (i.e., Internet Service Providers) or private access providers to corporate LANs, providing services based on the Internet Protocol (IP). In some cases, the NSP and the NAP can be a single organization.

One or more Hotwire DSLAMs are connected to a Wide Area Network Concentrator (WAN-C) via a LAN. The WAN-C concentrates data traffic from one or more DSLAMs into facilities providing access to the WAN. The WAN-C can be either a router (a layer 3 networking device) or a VLAN switch (a layer 2 networking device).

- **If WAN-C is a router**, the WAN must be a routed IP network (i.e., a network of interconnected IP routers).

  In this case:

  — The router at the wire center is required to support routing policies which permit packets arriving from the local DSLAMs to be routed based on the service subscriber source IP address. The packets are routed to the subscribed service providers' POP based on the source IP address.

  — The routing tables in the DSLAM are configured such that the next-hop router is the IP address of the wire center router for all authorized subscriber IP source addresses. (See the discussion on source-based routing in Chapter 6, *IP Routing*.)

  In addition, the router at the regional center may need to participate in an exterior gateway protocol, such as the Border Gateway Protocol, to exchange routing information between the NSP and NAP routing networks.

  — Packets flowing from the NSP network to the end-user systems are routed within the NAP network based on the packet destination IP address.

- **If WAN-C is a VLAN switch**, the WAN must be a layer 2 switching network supporting a Virtual LAN overlay.

  In this case:

  — Each NSP would be a member of a different Virtual LAN.

  — The VLAN switch at the wire center would support either port-based VLAN switching (i.e., switching all MAC frames received on a specific port to a specific NSP VLAN on the WAN) or port-based VLAN switching with MAC-based attributes (i.e., switching frames received on a specific port to a specific NSP VLAN on the WAN based on the destination MAC address) for packets sent from the DSLAMs.

  — The router at the NSP premises would either be front ended by a VLAN switch or have an integrated VLAN card that supports protocols consistent with the wire center VLAN switch (e.g., ATM Forum LAN Emulation Protocol).

  — The routing tables in the DSLAM are configured such that the next-hop address field points to the IP address of the NSP premises router for all authorized subscriber IP source addresses. (See the discussion on source-based routing in Chapter 6, *IP Routing*.)

— A different next-hop router is specified for each NSP address domain in contrast to the routed network case where a single next-hop router was specified for all NSP domains. If the DSLAM does not know the MAC address of the NSP premises router, it uses ARP to obtain the MAC address from the NSP premises router prior to forwarding the packet (i.e., the wire center VLAN switch forwards an ARP request over the WAN to the NSP router).

— Packets flowing from the NSP network to the subscribers are routed to the subscriber based on the destination IP address of the subscriber as is most common for IP-routed networks. In this case, the LAN on which the DSLAM resides appears to be part of a local subnet connected directly to the NSP premises router. If the NSP router does not know the MAC address of the subscriber, it uses ARP to obtain the MAC address from the DSLAM that acts as a proxy for the subscriber. (See the discussion on proxy ARP in Chapter 2, *Service Domain Features*.)

Understanding the Domain Types

Functionally, the Hotwire DSLAM network model can be divided into:

- Features supporting customers

  Features integral to supporting customers are the DSL cards and Hotwire RTUs.

- Features supporting overall system management

  The central point of access for overall system management is the MCC card. However, the features integral to supporting overall system management are also distributed throughout the Hotwire DSLAM and the Hotwire RTUs.

To monitor and control the operation of the overall system, the IP addresses of the Hotwire DSLAM and the Hotwire RTU must be partitioned into two distinct domains.

- **Service domain(s)**

  The service domain (also known as the NSP domain) resides in a mutually exclusive domain from that of the management domain. (There should be one service domain for each NSP served by the Hotwire DSLAM.) One service domain encompasses an NSP and all of the end-user systems that subscribe to that NSP.

  For more information about the service domain, its features and components, see Chapter 2, *Service Domain Features*, and Chapter 4, *Components of the Network Model*.

- **Management domain**

  The management domain resides in a mutually-exclusive domain from that of the service domains. The NAP provisions IP addresses for the management domain.

  For more information about the management domain, its features and components, see Chapter 3, *Management Domain Features*, and Chapter 4, *Components of the Network Model*.

For more information about assigning IP addresses, see Chapter 5, *IP Address Allocation*.

Service Domain Features

2

Overview

This chapter describes the following features that are supported in the service domain:

- Protocols
- Address Resolution Protocol (ARP) with Proxy ARP
- Filtering

Protocols

The Hotwire DSLAM and Hotwire RTUs forward IP packets between the end-user system and the Network Service Provider using the following protocols:

- **Point-to-Point Protocol/High-level Data Link Control (PPP/HDLC)**

  Packets transmitted over DSL links on an 8546 DSL card are encapsulated in PPP/HDLC frames. PPP/HDLC is not supported on the 8540 DSL card.

- **MAC**

  Packets transmitted over LAN ports are encapsulated in Ethernet II MAC frames.

- **IP**

  IP packets arriving over the DSL interface are forwarded to the LAN interface. IP packets arriving over the LAN interface are forwarded to the appropriate DSL interface.

  NOTE:

  Directed broadcasts (also referred to as *subnet broadcasts* — all 1s (ones) in the host field) are forwarded upstream, but are not forwarded downstream.

  Multicast is not supported.

- **Internet Control Management Protocol (ICMP)**

  In general, ICMP is supported. However, the options field is not reflected back if the Hotwire DSLAM is the destination address (i.e., the Hotwire DSLAM receives the data and then returns the packet without the options field). The Hotwire DSLAM does, however, pass the packet with the options field to the next hop if the DSLAM is not specified as the destination address.

- **Dynamic Host Configuration Protocol (DHCP)**

  DHCP is the protocol used for automatic IP address assignment. A DHCP discover or request message from an end-user system is transmitted over DSL ports and forwarded to the designated DHCP server, which is typically maintained and operated by the NSP for its address domain. The DHCP server assigns an IP address to the end-user system. The Hotwire RTU routing tables and the DSLAM routing tables are automatically updated with the IP address information by the DSLAM.

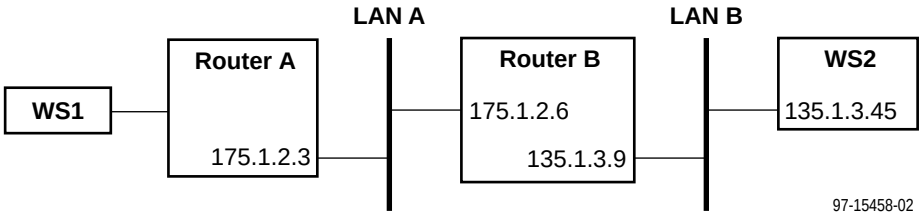
Proxy ARP (Theory of Operation)

An Address Resolution Protocol (ARP) request is used to dynamically bind an IP address to a MAC address. Proxy ARP is a technique by which a router answers ARP requests intended for another machine by supplying its own MAC address (also referred to as the physical address). By answering for another device, the router accepts responsibility for forwarding packets to that device.

ARP is supported by the Hotwire DSLAM and the Hotwire RTU. Proxy ARP allows the end users to appear to be directly connected to the router or VLAN switch providing access to the NSP network. This is an advantage because routers connected to a device running proxy ARP require less configuration. The following scenarios show why this is an advantage.

Scenario 1: Without Proxy ARP

In this scenario, Router B does not have proxy ARP software and the networks of the default router (Router A) for workstation 1 (175.1.2.3) and workstation 2 (135.1.3.45) are different.



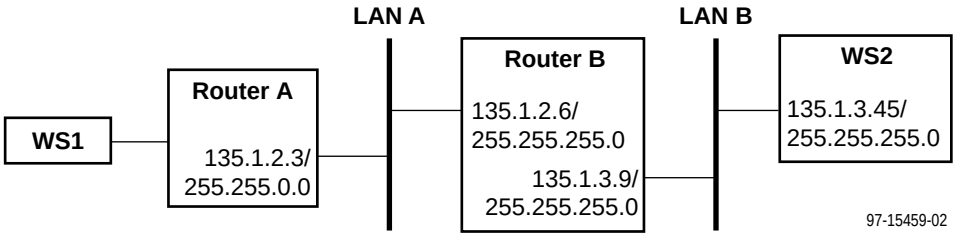
Workstation 1 (WS1) needs to send a packet to workstation 2 (WS2). For the packet to arrive successfully at WS2:

- There is a static route on Router A for WS2. The next hop is Router B and the destination is WS2.
- WS1 sends a packet to Router A.
- Router A consults its routing table to determine the next hop address (i.e., router IP address) for WS2 because WS2 is on another network (135.1.0.0).

Now that it knows the next hop address to Router B, Router A then ARPs for Router B. Router B receives the ARP request for its IP address and does an ARP reply with its MAC address. After Router A receives the ARP reply, it sends the packet to the Router B which, in turn, forwards it to WS2.

Scenario 2: With Proxy ARP

In this scenario, Router B is running the proxy ARP software, and WS2 and Router A for WS1 are on the same network (135.1.0.0).



WS1 again needs to send a packet to WS2. This time, however, Router B is running proxy ARP and knows that WS2 lies on LAN B on the same logical subnetwork as Router A (135.1.0.0). Router B uses proxy ARP to maintain the illusion that only one physical network exists. Router B keeps the location of WS2 hidden from Router A, allowing Router A to communicate as if directly connected to WS2.

NOTE:

Router A does not need a static route entry for the WS2 route because the two LANs appear to be one.

Therefore, when WS1 needs to send a packet to WS2, this is the sequence of events:

- WS1 sends a packet to Router A.
- Router A invokes ARP to map the WS2's IP address into a MAC address, because WS2 appears to Router A to be on the same 135.1 subnet.
- Router B running proxy ARP software receives the broadcast ARP request from Router A, knows that WS2 is on LAN B, and responds to Router A's ARP request with its own MAC address.
- Router A receives the ARP reply, then sends the packet to the MAC address of Router B.
- Router B then forwards the packet destined for WS2 on LAN B.

NOTE:

The proxy ARP capability is card- or system-dependent and detailed examples for the MCC card, DSL card, and Hotwire RTU are given in Chapter 4, *Components of the Network Model*.

Filtering

By default, filtering is disabled on the Hotwire DSLAM system, but you can enable filtering to selectively filter source or destination packets being routed through the MCC or DSL cards. Filtering provides security advantages on LANs by restricting traffic on the network and hosts based on the IP source and/or destination address.

For more information about filtering, see Chapter 7, *IP Filtering*. For more information about dynamic IP addressing and the dynamic access control option, see Chapter 5, *IP Address Allocation*, and the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Management Domain Features

3

Overview

This chapter describes the following features that are supported in the management domain:

- Network Management Systems (NMSs)
- Applications for Diagnostics

Network Management Systems – SNMP and DCE Manager

You may want to use an SNMP NMS to simplify the operation and management of very large networks. In a UNIX environment you may use HP OpenView (UNIX) as your NMS with Paradyne's OpenLane DCE Manager, or in a Windows environment, HP OpenView (MS-Windows) with Paradyne's OpenLane DCE Manager. The Hotwire DSLAM and Hotwire RTUs provide features for the OpenLane DCE Manager to allow you to monitor and manage your network from a central point.

The following lists some of the features of DCE Manager:

- Graphical User Interface (GUI) showing physical representation of the Hotwire DSLAM and each active card
- Multiple integrated functions to provide on-demand health and status information
- Color-coded graphic representations to provide instant visual status
- Loopback and pattern tests via Telnet to help isolate problems quickly
- Integrated management optimizes network performance and availability
- Direct Telnet support

These SNMP capabilities provided by Paradyne's OpenLane DCE Manager provide access to MIB II, Entity MIB, and private-enterprise MIB extensions to monitor information.

The DSLAM uses a processor card called the MCC card in conjunction with DCE Manager. The MCC card provides the single management interface to the Hotwire DSLAM cards and RTUs. The MCC card gathers operational status for each of the Hotwire DSL cards in the DSLAM and RTUs, and reports events and alarms to the DCE Manager. For more information, see the *OpenLane DCE Manager for HP OpenView for Windows User's Guide* or the *OpenLane DCE Manager User's Guide*.

Applications for Management Domain

The Hotwire DSLAM user interface provides the following management applications:

- Ping
- TraceRoute
- Trivial File Transfer Protocol (TFTP) client
- Telnet

Ping

The Ping program is an IP-based application used to test reachability to a specific IP address by sending an ICMP echo request and waiting for a reply. It is supported from both the DSL and MCC cards. As a diagnostic tool, the Ping program from the MCC card can be used to verify reachability in the management domain to the DSL card, the Hotwire RTU, and the DCE manager. Similarly, invoking the Ping program from the DSL card can test the service and management domains by verifying reachability downstream to the Hotwire RTU and the end-user system (ES), and to verify reachability upstream to the NSP.

NOTE:

Record route and other ICMP options facilitating trace route are also supported. However, the options field is not reflected back if the Hotwire DSLAM is the destination address (i.e., the Hotwire DSLAM receives the data and then returns the packet without the options field). The Hotwire DSLAM does, however, pass the packet with the options field to the next hop if the DSLAM is not specified as the destination address.

For more information, see Chapter 7, *Diagnostics and Troubleshooting*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

TraceRoute

The TraceRoute program is a TCP/IP diagnostic tool that allows you to learn the path a packet takes from its local host to its remote host. If you are unable to ping a device in a Hotwire network configuration, you may want to run TraceRoute to identify the links (destinations up to 64 hops) between the DSL card and an RTU as well as which device is not forwarding the ping message.

For more information, see Chapter 7, *Diagnostics and Troubleshooting*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

TFTP Client

The MCC card and DSL cards in the DSLAM provide client TFTP applications that work with the firmware download and configuration upload or download features. TFTP sessions are established between the MCC card or the DSL card to a TFTP server accessible through the LAN interface. In the case of a firmware download to an RTU, a TFTP session is established between the corresponding DSL card and the TFTP server.

A recommended use for configuration transfers is to upload a DSL card configuration to save (archive) the configuration set. Then, if necessary, you can recover the configuration by downloading (restoring) the saved configuration.

You can also initiate configuration downloads from the SNMP manager to the MCC and DSL cards. If the SNMP-initiated configuration download succeeds, then the DSL card will reset after the completion of the configuration download and a Configuration Change Notice (CCN) trap is sent. If the SNMP initiated configuration download fails, a download failure trap is sent. These traps are sent only if they have been configured on the SNMP Communities/Traps screen.

For more information, see Chapter 5, *DSL Card Configuration* and Appendix C, *Download Code and Apply Download*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Telnet

The Hotwire DSLAM system provides support for Telnet, which is a simple remote terminal protocol that is part of the TCP/IP protocol suite. With Telnet, a network administrator can establish a virtual access connection to the Hotwire DSLAM from a remote client to configure or monitor the Hotwire DSLAM. The user interface presented for a Telnet session is the same as that used with the DSLAM's local serial port.

A Telnet connection from the Hotwire DSLAM to another Hotwire DSLAM or remote server is also supported. This feature is supported from the Ethernet (10BaseT) interface on the MCC card.

For more information, see Chapter 7, *Diagnostics and Troubleshooting*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Components of the Network Model

4

Overview

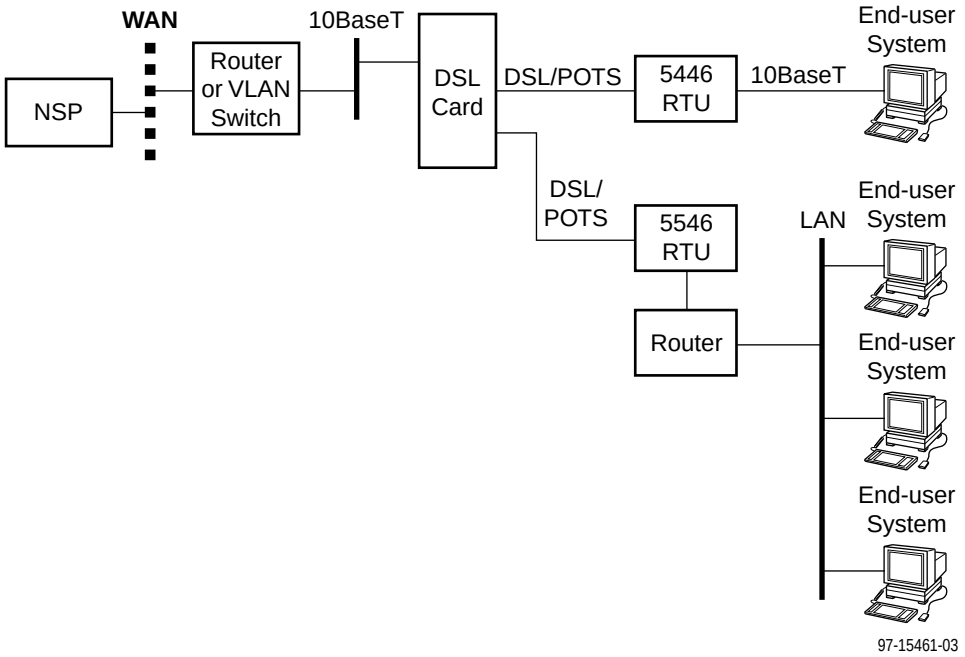
The service and management domains logically comprise the network model. This chapter describes the components that comprise these domains.

Service Domain Components

The primary purpose of the service domain network is to provide IP routing of customer data between the Network Service Provider (NSP) and the end-user system (ES).

The basic service domain configuration consists of the following components:

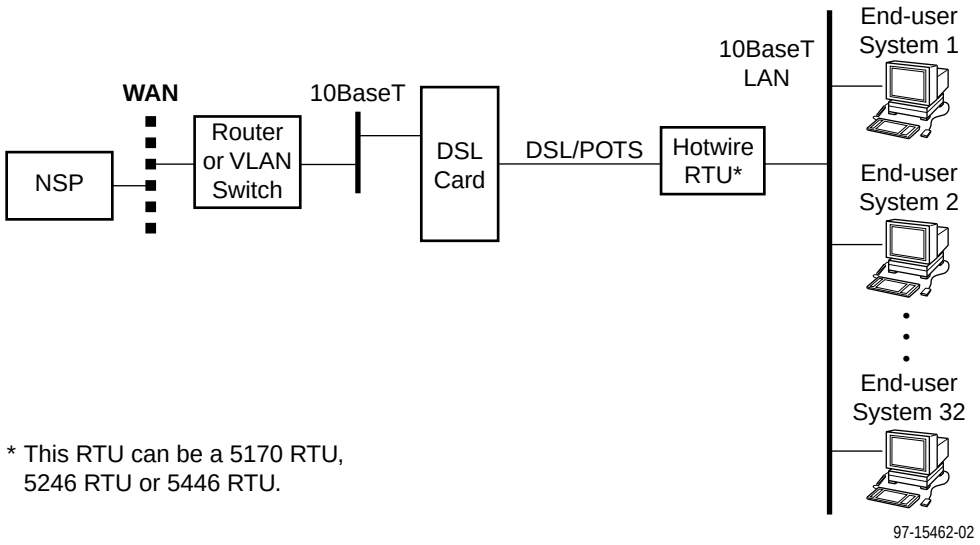
- An end user (PC or workstation) or multiple users on an Ethernet LAN connected to the Hotwire RTU, which in turn, is connected to one of the DSL card ports of the Hotwire DSLAM.
- In the case of a 5546, the end user will be connected to a router attached to the RTU.
- The 10BaseT port of the Hotwire DSLAM DSL card connected to a router or switch that may also reside in the central office (CO) or wire center.
- The router or switch is then connected to the NSP typically over a Wide Area Network (WAN).
- The NSP may also be directly connected to the same LAN as the DSL card.


WAN
10BaseT
End-user System
NSP
Router or VLAN Switch
DSL Card
DSL/POTS
5446 RTU
10BaseT
DSL/ POTS
5546 RTU
LAN
End-user System
Router
End-user System
End-user System
97-15461-03

The following illustration shows another internetworking configuration. This configuration has multiple end users connected to the Hotwire RTU using a hub. The number of supported end-user systems depends on whether you use a host or structured subnetting. For more information, see Chapter 5, *IP Address Allocation*.

NOTE:

This illustration does not apply to the 5171 PC NIC and 5216 RTU. The 5171 PC NIC and 5216 RTU are for single end-user system configurations only. They do not support multiple end-user system configurations.

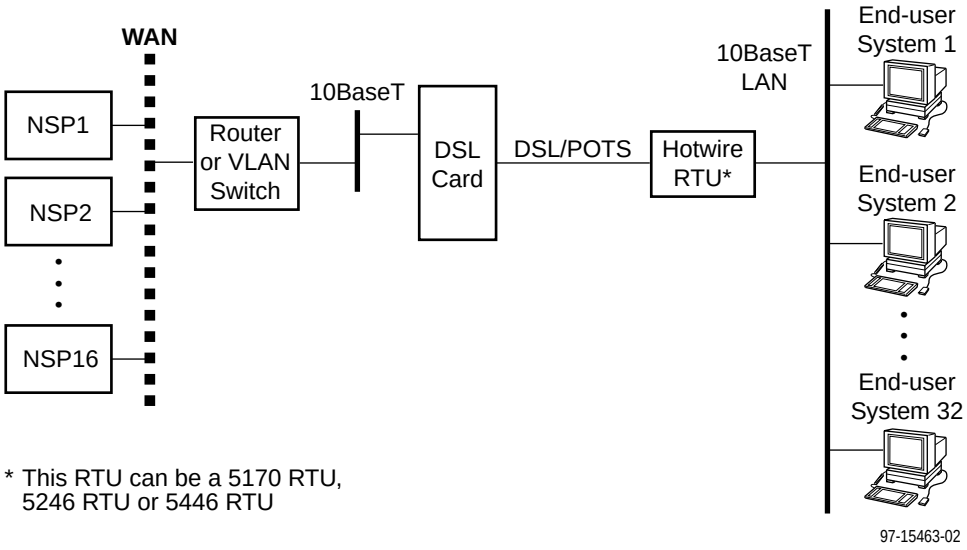


When multiple end users are connected, they may opt to access different NSPs, as illustrated on page 4-4. When all 18 DSL cards are used, the Hotwire DSLAM can support simultaneous access up to 288 different NSPs or private intranets by the end users (16 NSPs or private intranets per DSL card).

A maximally configured Hotwire DSLAM system will have 18 DSL cards with each DSL card having its four ports connected to a Hotwire RTU for a total of 72 modem ports. Each modem can connect via a hub to 32 active end-user systems to support a total of 2304 users.

NOTE:

The following illustration does not apply to the 5171 PC NIC and 5216 RTU. The 5171 PC NIC and 5216 RTU are for single end-user system configurations only.



Additionally, by setting up structured subnets behind each Hotwire RTU, hundreds of active end-user systems can be supported by each 5446 RTU instead of 32. Careful network traffic analysis must be performed to determine if very large networks will have acceptable response times. For information on how to set up structured subnets, see Chapter 5, *IP Address Allocation*.

NOTE:

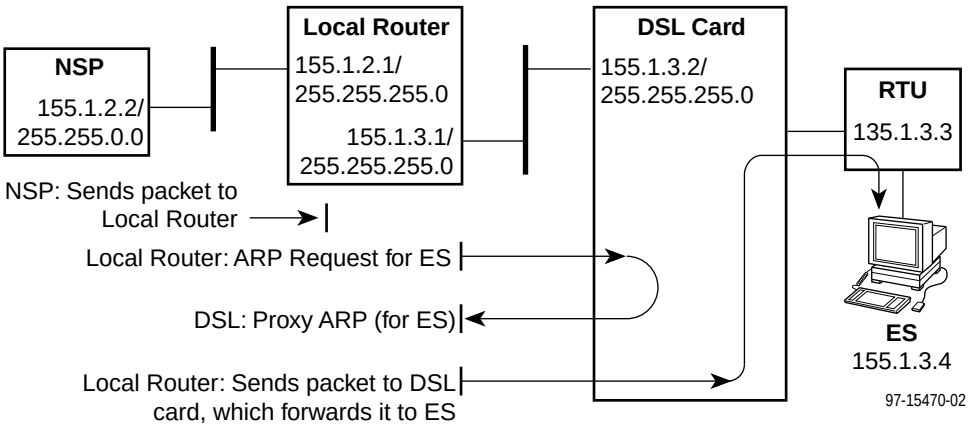
Usually a user is active only in one service domain at a time. However, if the end user's system can be multihomed, it may be possible to be active in more than one NSP domain at a time. A **multihomed** system is a system with connections to two or more logical networks, which may be assigned to one or more physical networks.

Proxy ARP

Proxy ARP is supported by the DSL cards and the Hotwire 5446 RTU. It allows the end users to appear to be directly connected to the router providing access to the NSP network. This is an advantage because routers connected to a device running proxy ARP require less configuration. The following scenarios show why this is an advantage.

DSL Card Proxy ARP

When an ARP request is sent by an NSP connected to the DSL card 10BaseT interface for a downstream end-user system (one on the same IP network), the DSL card will proxy ARP for the ES. The following figure shows the packet flow when the NSP wants to send a packet to the ES.



In this illustration:

- The local router receives the IP packet and does an ARP request for the ES.
- The DSL card receives the broadcast ARP request. The DSL card does an ARP reply for the ES by replying with its own MAC address. Addresses for which the DSL card will proxy ARP must be configured as part of static route configuration. See the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide* for more information.
- When the local router receives the ARP reply, it sends the packet to the DSL card, and the DSL card forwards it to the ES.

NOTE:

In certain network configurations, the use of proxy ARP on the DSL cards will cause HP OpenView to log a major event. This will happen since HP OpenView received the same IP address from two different MAC addresses.

By default, the HP OpenView system logs and displays all events. However, you may elect to filter specific unwanted events. Instructions on how to filter out these events are dependent on the release of HP OpenView/Netview that you are running. For detailed instructions, see the appropriate HP OpenView user documentation.

5446 RTU Proxy ARP

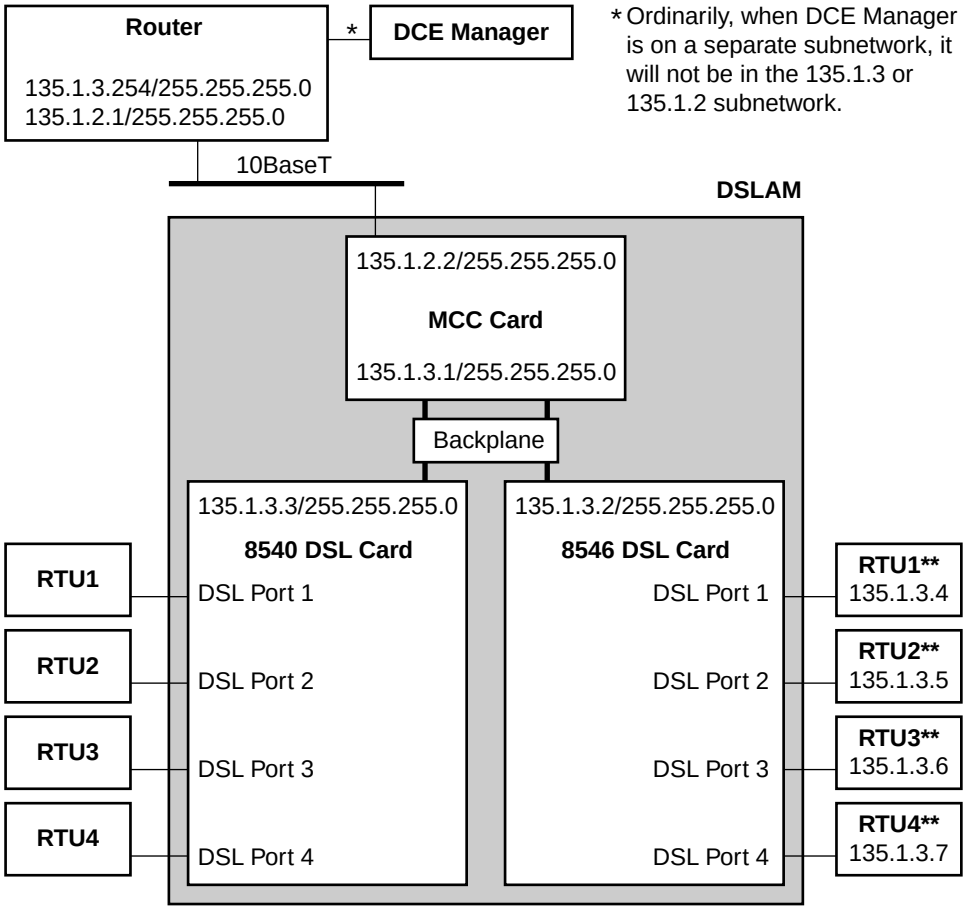
The Hotwire 5446 RTU utilizes proxy ARP to enable connectivity between end systems that are attached to separate RTUs, but reside on the same subnetwork. The Hotwire 5446 RTU will proxy ARP for the end-user system that is physically connected to another Hotwire 5446 RTU where the destination end-user system is logically connected to the same subnetwork as the sender end-user system.

5546 RTU

If structured subnetting is used and end systems need to communicate with systems in the same natural subnet, the router attached to the 5546 RTU must enable Proxy ARP on the interface to which the end system is connected.

Management Domain Components

The following illustration shows the components of the network management domain. Note that the router between the MCC card's 10BaseT interface and the DCE Manager is optional. The MCC card, as previously noted, provides consolidated management for the DSL cards and Hotwire RTUs from remote network management workstations by means of SNMP, telnet, or by local access through its VT100-serial interface.



** Applies only to the 5446 RTU

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To facilitate management of the DSL cards and Hotwire RTUs through the MCC card:

- Assign IP addresses from the management domain to the internal backplane interfaces of each DSL card and 5446 RTU interface in the same subnet as the MCC card's backplane interface (as shown in the previous illustration). This is a separate subnetwork from the MCC card's 10BaseT port.

  In the case of the 5546 RTU, the IP address of the router interface connected to the RTU should reside in the same subnet as the MCC card's backplane address.

  These IP addresses are stored in the Entity MIB on the MCC card where they can be accessed by the NMS.

  NOTE:

  Management functions of RTUs associated with an 8540 DSL card are performed by an internal agent on the 8540 DSL card. Management functions of the 5546 RTU are performed by an internal agent on the 8546 DSL card.

- Provide IP addresses on the router's interface attached to the MCC card for both subnetworks, so that the router appears to be directly connected to the MCC card's Ethernet interface as well as the Hotwire DSLAM system backplane.

  In other words, the router's interface to the MCC can be multihomed to support proxy ARP.

Discovering Devices on the Network (Discovery)

In the illustration on page 4-7, the IP addresses assigned for the router's interface to the MCC card are 135.1.2.1 and 135.1.3.254. The second IP address (135.1.3.254) is on the same subnetwork (135.1.3.0) as the internal addresses of the DSL cards and the Hotwire RTUs. The MCC card will not forward broadcasts on the management network (135.1.2.n) across the Hotwire DSLAM system backplane because it is a separate subnetwork, as the DSL cards do not need to be *discovered* by the management system.

How does an NMS learn the address of a device beyond the MCC card?

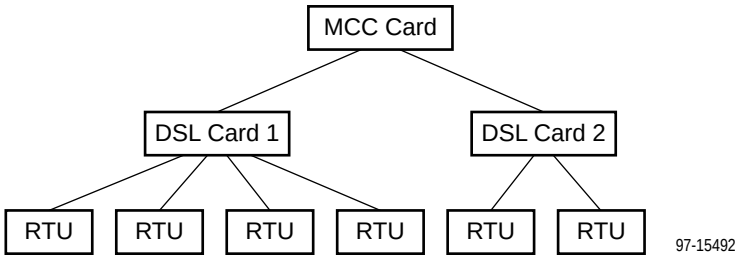
- DCE Manager gets the IP address of a DSL card from the Entity MIB on the MCC card.

  After the DCE Manager has learned the IP address of a DSL card through the Entity MIB, it addresses management traffic directly to that card.

- DCE Manager gets the IP address of the 5446 RTU from the Entity MIB on the DSL card.

  After the DCE Manager has learned the IP address of the RTU through the Entity MIB, it addresses management traffic directly to that RTU.

When the Hotwire DSLAM and Hotwire RTU systems networks are configured as described above, the DCE Manager provides a view of the entire network from information contained in the MCC card's entity MIB.



NOTE:

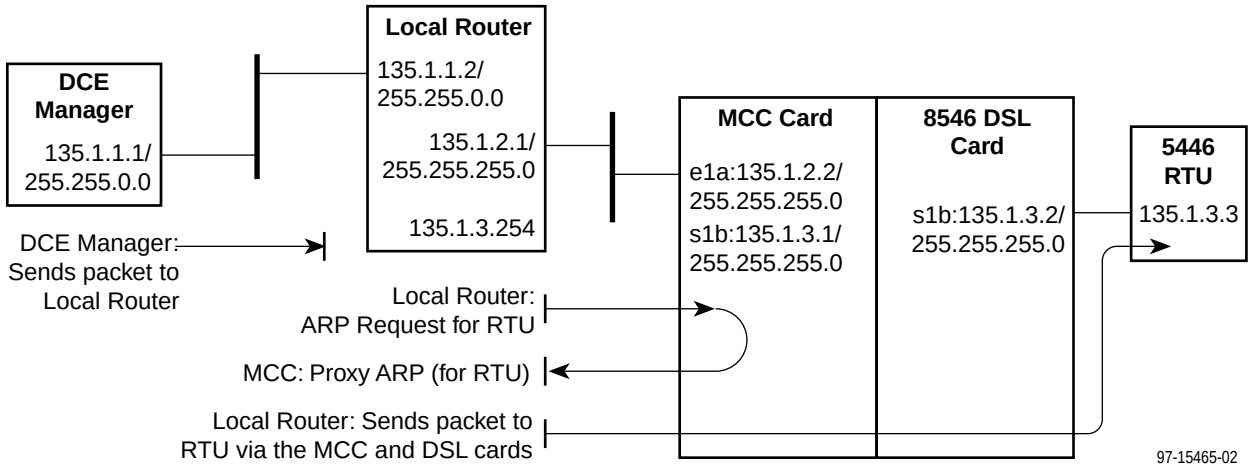
It is not recommended that the DCE Manager access a DSL card via its Ethernet port because the Entity MIB on the DSL card does not reflect a view of the entire Hotwire DSLAM system. It reflects only the view of the DSL card *discovered*. Also, in a fully configured DSLAM, 18 additional devices will be discovered and appear on your network map.

If you want to manage DSL devices across the NSP network, use telnet. For more information on telnet see Chapter 7, *Diagnostics and Troubleshooting*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

MCC Card Proxy ARP

Proxy ARP is also supported by the MCC card. In a Hotwire DSLAM network configuration, when an ARP request is sent by a device (such as a router) to the MCC card's 10BaseT interface to resolve either the DSL card or Hotwire 5446 RTU MAC address, the MCC card will proxy ARP for those devices so long as their IP addresses are on the same network (135.1.3.n) as the backplane interface of the MCC card. The MCC card responds to these ARP requests with its own MAC address (proxy ARP). Incoming packets are then forwarded to that appropriate DSL card across the Hotwire DSLAM system backplane.

The following illustration shows the packet flow when the DCE Manager wants to send a packet to the Hotwire 5446 RTU using proxy ARP.



In this illustration:

- The local router does an ARP request to acquire the Hotwire 5446 RTU MAC address.
- The MCC card is in the same network (135.1.3.1) and sees the ARP request. The MCC card contains a route to the Hotwire RTU and knows the RTU is downstream (generally a host route). The MCC card does an ARP reply for the Hotwire 5446 RTU by responding with its own MAC address.
- When the local router receives the ARP reply, it forwards the packet to the MCC card. The MCC card forwards it to the DSL card which forwards it to the Hotwire 5446 RTU.

For security reasons, a separate management domain is recommended. However, the management and service domains can share the same subnet. Separation can be maintained by extending the subnet mask down to the fourth octet (255.255.255.255).

For example, one management subnet and three service domain subnets could use the combined subnet mask: 135.1.2.0/255.255.255.0. The management subnet could be 135.1.2.192/255.255.255.192 and service domain subnets could be 135.1.2.0/255.255.255.192, 135.1.2.64/255.255.255.192, and 135.1.2.128/255.255.255.192. With these subnet masks, management addresses use the top quarter of the range (135.1.2.192 through 135.2.2.254) and service addresses use the lower three-quarters (135.1.2.1 through 135.1.2.191).

IP Address Allocation

5

Overview

IP addresses are assigned throughout the network model for components comprising both the service and management domains. This chapter describes the IP address allocation schemes for the components that make up the Hotwire DSLAM network model. It also describes the naming convention used for the Hotwire DSLAM system interfaces.

Port Naming Convention

The following is the naming convention used for the Hotwire DSLAM interfaces:

NOTE:

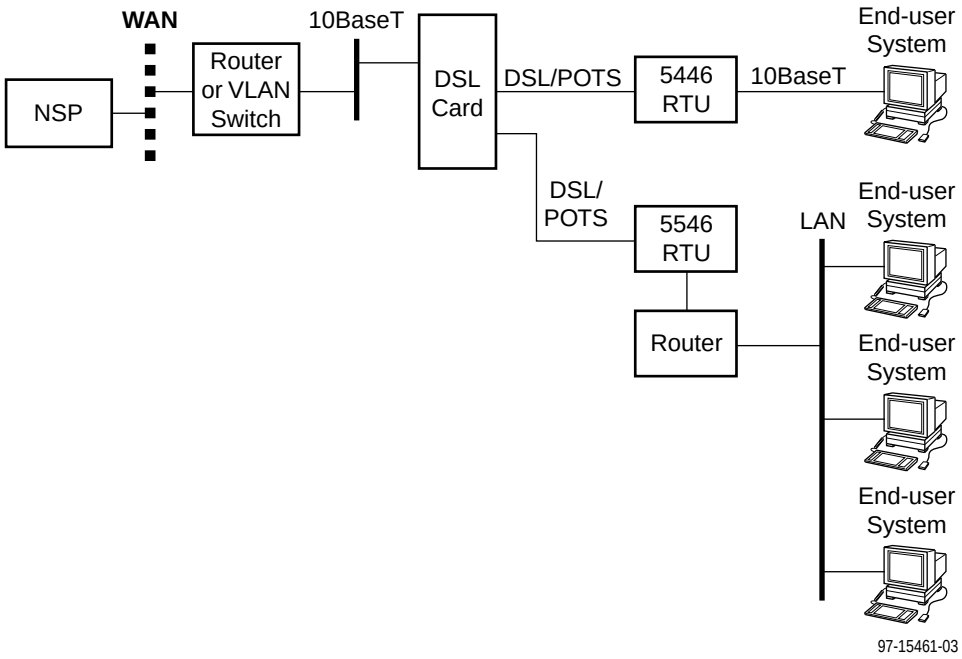
Interfaces are sometimes referred to as ports. The term *ports*, however, usually is reserved for referring to the physical layer attributes of an interface.

- **e1a** – Interface name of the DSLAM system 10BaseT interface on the MCC and each DSL card.
- **s1b** – Interface name of each card's interface to the DSLAM system backplane bus.
- **s1c**, **s1d**, **s1e**, and **s1f** – Interface names of the four DSL ports on a DSL card.

NOTE:

These names are used throughout the remainder of this guide to reference the Hotwire DSLAM interfaces. These are also the names used in the Hotwire DSLAM software when configuring the Hotwire DSLAM system.

The following illustrates the logical interface naming convention.



Assigning IP Addresses

In the Hotwire DSLAM network model, there are two distinct domains:

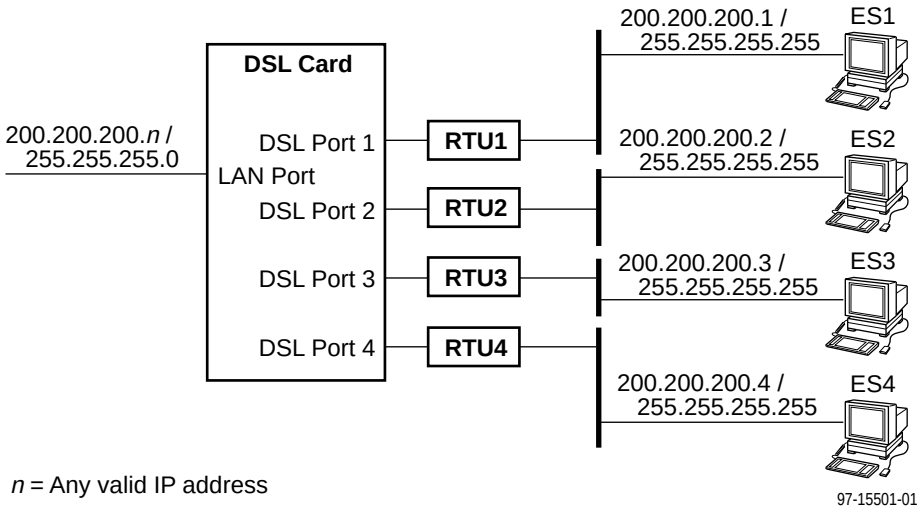
- a management domain
- a service domain

Within the management domain, there are two subnets as described in *Management Domain Components* in Chapter 4, *Components of the Network Model*. Within the service domain, one of two IP address allocation schemes can be followed: host addressing or structured subnet addressing. The following sections describe these schemes.

Host Addressing

Host addresses within the service domain are assigned to end-user systems. Because they are host addresses, they have a subnet mask of 255.255.255.255 and can be geographically dispersed. (When structured subnet addressing is discussed in the next section, you will see how IP addresses are allocated to certain areas.) This conserves address space, but may not scale well to large numbers of end-user systems. Manual configuration is required for every host address and routing performance may be decreased.

The following illustration is an example of host addressing.



Structured Subnet Addressing

As an alternative to using host routes for end-user systems, structured subnetting can be used. It scales better and performs better, but it does not allow geographically dispersed subnets.

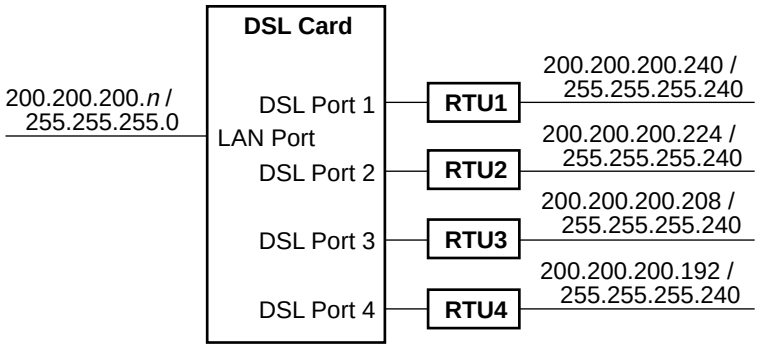
> **NOTE:**
>
> Structured subnetting is supported on the 8546 DSL card and the 5446 RTU. It is not supported, however, on the 8540 DSL card and its corresponding RTUs on the DSL ports. For 5546 RTUs, the router attached to the RTU must be configured with structured subnets.

The Network Service Provider's IP address itself is a host IP address which uses a subnet mask. This subnet mask includes all interfaces from the 5446 RTU.

Structured subnet addressing uses the following method:

- Within the service domain, the NSP would provision a subnet of its domain to a DSL card and all devices behind it.
- The NSP would further subdivide that subnet into four additional subnets (one behind each DSL port).

The following illustration is an example of structured subnet addressing.



n = Any valid IP address, but not within the other subnets

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To understand why this subnetting scheme works, you may want to consider the IP addresses and subnet masks in hexadecimal:

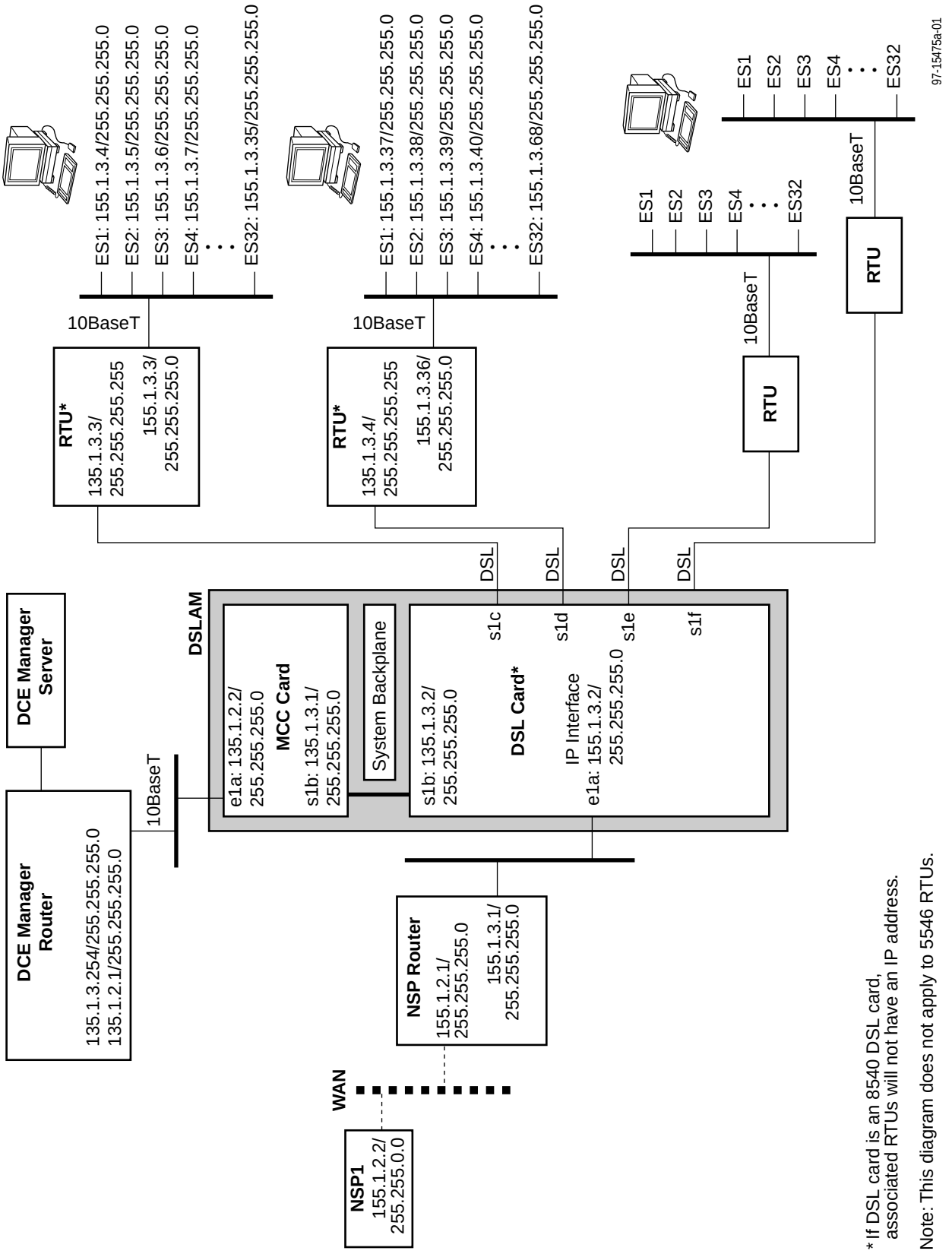
Dotted Decimal	Dotted Hexadecimal
200.200.200.00 / 255.255.255.0	C8.C8.C8.00 / FF.FF.FF.00
200.200.200.240 / 255.255.255.240	C8.C8.C8.F0 / FF.FF.FF.F0
200.200.200.224 / 255.255.255.240	C8.C8.C8.E0 / FF.FF.FF.F0
200.200.200.208 / 255.255.255.240	C8.C8.C8.D0 / FF.FF.FF.F0
200.200.200.192 / 255.255.255.240	C8.C8.C8.C0 / FF.FF.FF.F0

In the previous illustration:

- Each of the four DSL ports is on a different subnetwork of size 16, and the subnet mask for the four ports is 255.255.255.240.
- The LAN port (10BaseT port) IP address is 200.200.200.*n* (where *n* can be any valid IP address, but cannot be an IP address within the other subnets), and its subnet mask is 255.255.255.0.

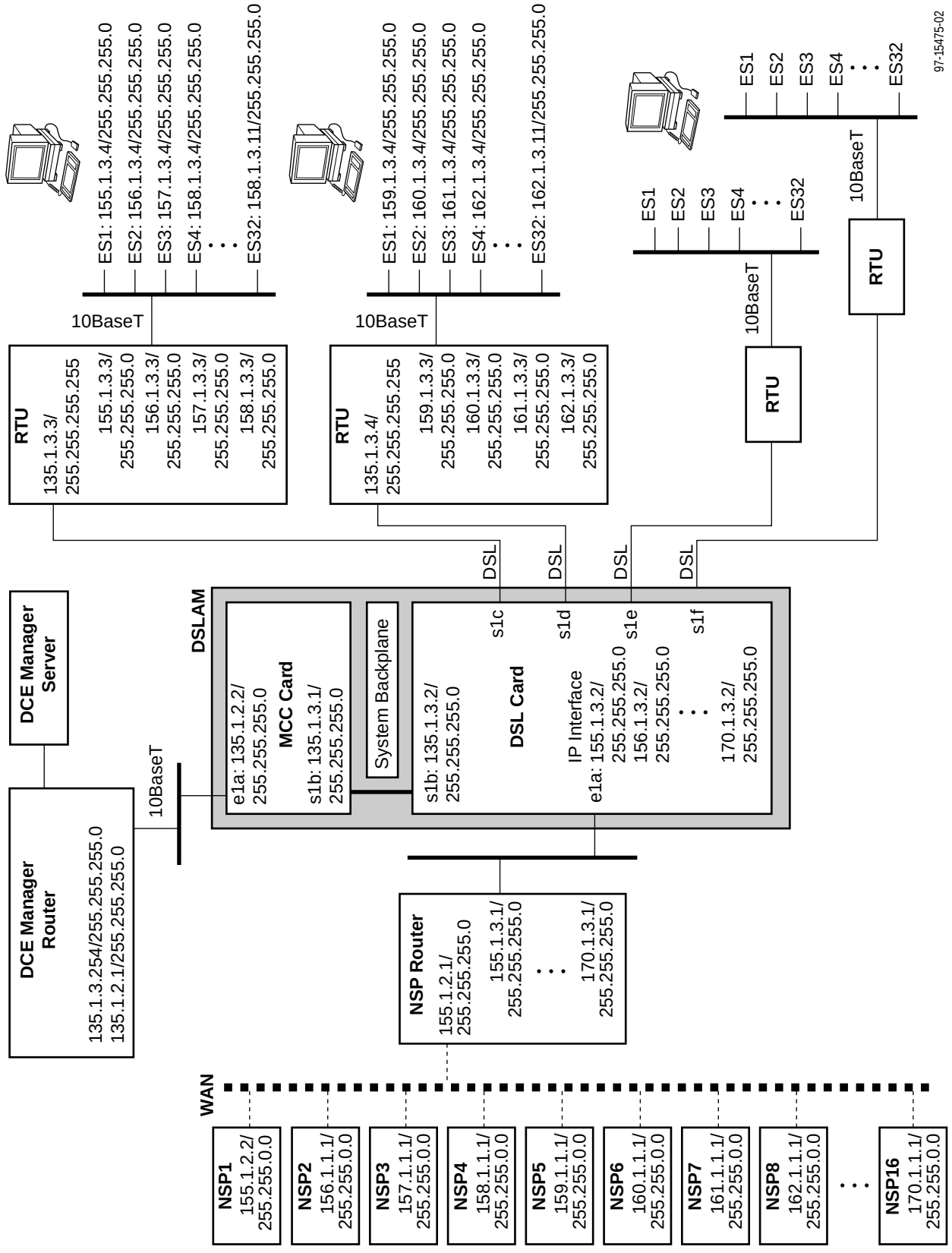
The illustration on page 5-6 shows one NSP connected to one DSL card, while the illustration on page 5-7 shows 16 NSPs connected to one DSL card. On page 5-7, the NSP router is multihomed to support all 16 NSPs. Also, each RTU has 32 end-user systems (ES).

In summary, if 32 end-user systems are connected to the DSL card's port 1 (s1c) and all are using host addressing, then 32 host routes must be configured on the RTU. If they are using structured subnet addressing, then only one route is configured on the 5446 RTU or the router attached to a 5546 RTU. Remember that structured subnet addressing applies only to the 5446 and the 5546 RTUs.



* If DSL card is an 8540 DSL card, associated RTUs will not have an IP address.

Note: This diagram does not apply to 5546 RTUs.


97-15475-02
ES1: 155.1.3.4/255.255.255.0
ES2: 156.1.3.4/255.255.255.0
ES3: 157.1.3.4/255.255.255.0
ES4: 158.1.3.4/255.255.255.0
ES32: 158.1.3.11/255.255.255.0
10BaseT
RTU
135.1.3.3/
255.255.255.255
155.1.3.3/
255.255.255.0
156.1.3.3/
255.255.255.0
157.1.3.3/
255.255.255.0
158.1.3.3/
255.255.255.0
ES1: 159.1.3.4/255.255.255.0
ES2: 160.1.3.4/255.255.255.0
ES3: 161.1.3.4/255.255.255.0
ES4: 162.1.3.4/255.255.255.0
ES32: 162.1.3.11/255.255.255.0
10BaseT
RTU
135.1.3.4/
255.255.255.255
159.1.3.3/
255.255.255.0
160.1.3.3/
255.255.255.0
161.1.3.3/
255.255.255.0
162.1.3.3/
255.255.255.0
ES1
ES2
ES3
ES4
ES32
10BaseT
RTU
DSL
DSL
DSL
DSL
DCE Manager
Server
DCE Manager
Router
135.1.3.254/255.255.255.0
135.1.2.1/255.255.255.0
10BaseT
DSLAM
e1a: 135.1.2.2/
255.255.255.0
MCC Card
s1b: 135.1.3.1/
255.255.255.0
System Backplane
s1b: 135.1.3.2/
255.255.255.0
DSL Card
s1c
s1d
s1e
s1f
IP Interface
e1a: 155.1.3.2/
255.255.255.0
156.1.3.2/
255.255.255.0
170.1.3.2/
255.255.255.0
NSP Router
155.1.2.1/
255.255.255.0
155.1.3.1/
255.255.255.0
170.1.3.1/
255.255.255.0
WAN
NSP1
155.1.2.2/
255.255.0.0
NSP2
156.1.1.1/
255.255.0.0
NSP3
157.1.1.1/
255.255.0.0
NSP4
158.1.1.1/
255.255.0.0
NSP5
159.1.1.1/
255.255.0.0
NSP6
160.1.1.1/
255.255.0.0
NSP7
161.1.1.1/
255.255.0.0
NSP8
162.1.1.1/
255.255.0.0
NSP16
170.1.1.1/
255.255.0.0

Management IP Address Allocation

The primary functionality of the management domain is monitoring and configuring the network. To provide this capability, IP addresses must be allocated for the components that are monitored and configured by an NMS and MCC card.

Component	IP Address Requirement
MCC Card	The MCC card must have two IP addresses: ■ One IP address for connectivity to the NMS or Router (connecting to the NMS). This address is also known as the Router ID. ■ One IP address to communicate to the DSL cards (over the s1b system backplane interface) in the Hotwire DSLAM chassis. These two IP addresses must be on separate subnetworks of the NMS domain. That is, they can be on: ■ Completely separate networks (e.g., 135.1.0.0/16 and 143.1.0.0/24), ■ Completely separate subnets (e.g., 135.1.1.0/24 and 135.1.2.0/24), or ■ Subnets of the management domain (e.g., 135.1.0.0/16 and 135.1.2.0/24).
DSL Card	Each DSL card must have one management IP address in the same subnetwork as the MCC card's system backplane IP address. NOTE: The backplane subnet cannot be set to the same e1a subnet on that DSL card.
Hotwire 5446 RTU	Each 5446 RTU must have one management IP address in the same subnetwork as the MCC card's system backplane IP address. NOTE: Since there could be four Hotwire 5446 RTUs per DSL card and 18 DSL cards per Hotwire DSLAM, a maximally configured system would have 72 Hotwire 5446 RTU management IP addresses. These must be in the same subnetwork as the MCC card's system backplane interface and the 18 DSL cards' management IP addresses (total of 91 addresses).
Hotwire 5546 RTU	The IP address of the router interface connected to the 5546 RTU should reside in the same subnet as the MCC card's backplane.

NOTE:

Management functions of RTUs associated with an 8540 DSL card are performed by an internal agent on the 8540 DSL card. Management functions of the 5546 RTU are performed by an internal agent on the 8546 DSL card.

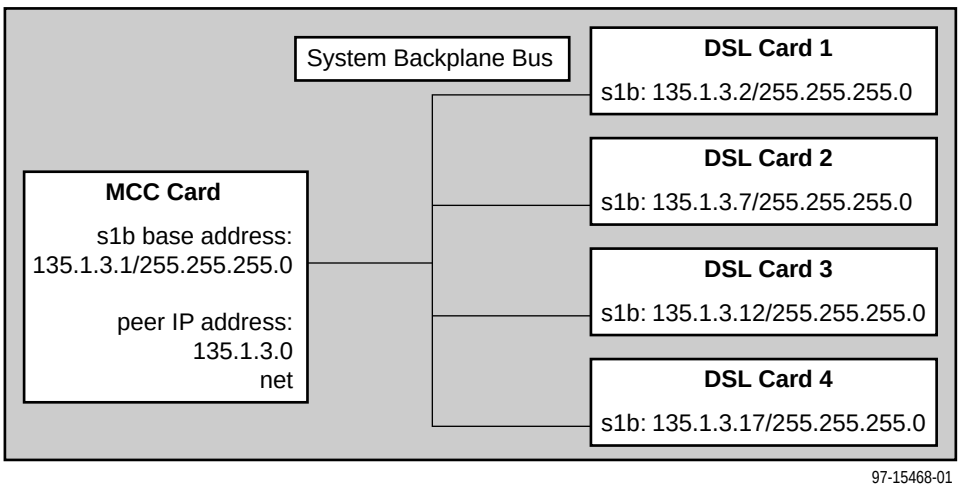
To configure the MCC card, the DSL card management IP addresses, and the Hotwire 5446 RTU management IP addresses, use the Hotwire DSLAM user interface. For step-by-step instructions, see Chapter 4, *Configuring the Hotwire DSLAM*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Peer IP Addresses

The s1b backplane ports are configured with peer IP addresses. **Peer IP addresses** are used to indicate directly-connected systems.

- For the MCC card's s1b (backplane) interface, the peer IP address should be set to indicate the subnet encompassing the DSL cards and RTUs.

  The following illustration shows a Hotwire DSLAM system configured with one MCC card and four DSL cards.



  — The IP address of the MCC card's s1b interface is 135.1.3.1.

  — The IP addresses of the DSL card's s1b interfaces are all in the same subnet (135.1.3).

  — Therefore, the directly connected peer subnet is its peer IP address, 135.1.3.0.

NOTE:

For structured subnetting on the backplane, the peer IP address must be the first in the subnet. For example, if s1b has an IP address of 135.1.3.65 and a subnet mask of 255.255.255.192, then the peer IP address must be 135.1.3.64.

- For the DSL card's s1c through s1f interfaces, the peer IP address should be set to indicate the management IP address of the directly connected 5446 RTU. In the case of a 5546 RTU, the peer IP address should match the IP address of the router interface connected to the RTU. (Peer IP addresses need to be set for 5446 and 5546 RTUs only. They do not apply to any other RTU type.)

  The peer address for the DSL card is a host route because the peer address identifies a specific 5446 RTU. Specifically, the peer address of each DSL card's DSL port is the Hotwire 5446 RTU's management IP address. The peer address is assigned to the 5446 RTU through Internet Protocol Control Protocol (IPCP) negotiation.

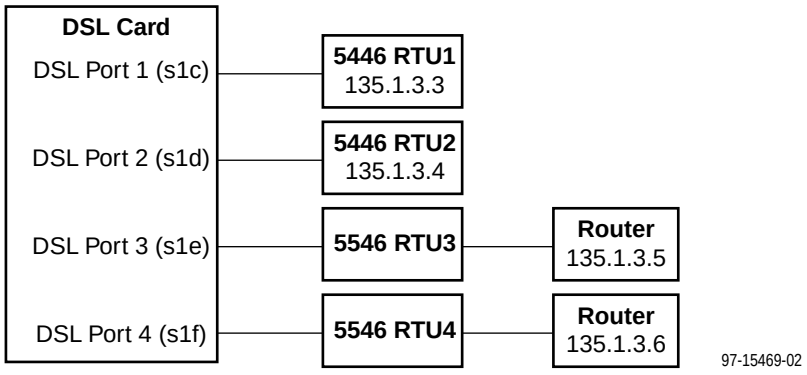
  The following illustration shows the DSL card with four 5446 or 5546 RTUs connected to its DSL ports. The peer address for the four DSL card ports are:

  — s1c = 135.1.3.3

  — s1d = 135.1.3.4

  — s1e = 135.1.3.5

  — s1f = 135.1.3.6



Service IP Address Allocation

Each NSP allocates IP addresses for the components in each service network as described below. How the IP addresses are allocated is also noted.

Component	IP Address Requirement
Service Domain Router	The router that routes NSP traffic to the Hotwire DSLAM DSL cards must have one IP address in each service domain. The router should be multihomed on its LAN port connection to the Hotwire DSLAM. Since 16 service domains are supported per DSL card and there can be 18 DSL cards per Hotwire DSLAM, up to 288 NSP IP addresses may be required on the router's interface to support a maximally configured Hotwire DSLAM system. However, typically you would organize your domains in such a way that fewer IP addresses would be needed.
DSL Card	Each DSL card can support 16 NSP domains (four for each Hotwire RTU). For each different NSP supported by the DSL card, there must be an IP address in the same domain for the DSL card 10BaseT interface (e1a). Therefore, the total number of DSL card IP addresses required is determined by the number of NSPs supported by the Hotwire RTUs.
Hotwire 5446 RTU	Each Hotwire 5446 RTU can support four NSP domains. Each Hotwire 5446 RTU with an end-user system in the domain of an NSP must have one service domain IP address in the same subnetwork. There could be: ■ Four service domain IP addresses per Hotwire 5446 RTU, ■ Four Hotwire 5446 RTUs per 8546 DSL card, and ■ 18 DSL cards per Hotwire DSLAM. This means that a maximally configured Hotwire DSLAM system with 72 Hotwire 5446 RTUs could have 288 service domain IP addresses. To configure the Hotwire 5446 RTU service domain IP addresses, see Chapters 4 and 5 of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.
End-User System (ES)	Each end-user system must have an IP address. The IP address is assigned by the NSP either statically or dynamically. For information about dynamic IP addressing, see the following section.

Dynamic IP Addressing

The Hotwire DSLAM system allows the use of Dynamic Host Configuration Protocol (DHCP) to facilitate the automatic assignment of end-user system IP addresses. With the dynamic IP addressing feature, NSPs can administer IP addresses to the end users dynamically (automatically) rather than statically (manually). An IP address can be reused once the end user no longer requires the address (i.e., the end-user system no longer requires access to the NSP) or the lease time has expired. This feature allows NSPs to maintain a pool of IP addresses that services many end users rather than one fixed IP address per end-user system.

In addition, an authentication feature can also be configured to confirm an end-user system's access location.

For more information about dynamic routes, see Chapter 6, *IP Routing*.

Recording Your Configuration Settings

It is recommended that you keep a record of your configuration settings when assigning IP addresses to the devices on your network. Appendix A, *Network Configuration Worksheets*, contains the worksheets to help you record those settings. Store the worksheets for reference, as needed.

You may also save your configuration settings (upload your configuration) on the TFTP server. For more information, see Chapter 5, *DSL Card Configuration* of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

IP Routing

6

Overview

This chapter presents information regarding the theory behind the configuration of routes (static and dynamic) on the Hotwire DSLAM, as well as examples. Both standard destination-based routes and source-based routes are described.

Routing Table

The **routing table** stores information about possible destinations for packets that are routed through the Hotwire DSLAM. It also identifies the next hop address to which to send the packet. The MCC, DSL cards, and RTUs maintain their own routing tables. There are two types of routes: static and dynamic. A **static route** is a permanent entry into the routing table that is manually entered. A **dynamic route** is an automatic (assigned) entry into the routing table; it does not need to be manually entered. Static routes can be destination based or source based. However, dynamic routes can be only destination based.

Although the Hotwire DSLAM routing table supports both destination-based routing and source-based routing, this section discusses destination-based routing only. (Source-based routing is discussed later in this chapter.)

The routing table is comprised of:

- Configured routes (static and/or dynamic)
- Routes learned by implication of directly connected hosts/networks
- Routes learned by the MCC card from the DSL about its directly connected hosts (RTUs)

With destination-based routing, the destination address of the packet being sent is compared to the destination address entries in the routing table. The destination address could possibly match one or more of three types of addresses in the routing table. It could match a:

- Host route address (that is, a specific destination IP address) e.g., 135.1.3.5, or
- Subnet route, e.g., 135.1.3.0, or
- Network route, e.g., 135.1.0.0.

If a match is found for more than one destination address, the order of precedence is:

1. Host route
2. Subnet route
3. Network route
4. Default route

Therefore, the packet is sent to the next-hop address specified for that destination which matches and has the highest precedence.

A packet routed through the Hotwire DSLAM that has a destination address not matching any entry in the routing table is dropped unless a default route is specified. If a default route is specified using the conventional address 0.0.0.0 as the destination IP address, the packet is sent to the associated next-hop address.

Static Routes for Static IP Addressing

If you plan to use static addressing, then you will need to create static routes to route to the end-user systems. Use the following routing table form:

Host/Net, Subnet Mask, Next Hop, Pref, S/D, PA

Where:

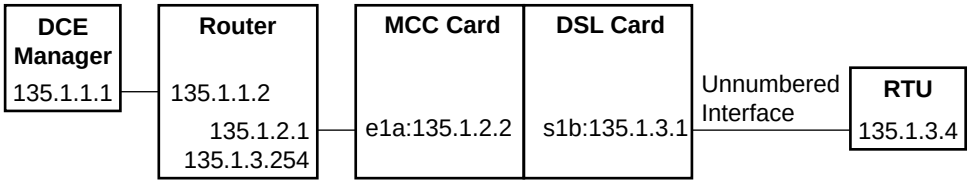
- The *Host/Net* is one of the following:
  - — A host address (for example, the specific IP address of an RTU or end-user system), or
  - — A subnet or network portion of a destination or source IP address, or
  - — The default route, which is defined to be 0.0.0.0.
- The *Subnet Mask* for host, subnet, or network. This is not applicable to default routes.
- The *Next Hop* is the IP address to which the given datagram should be forwarded. For example, the IP address of the router connected to the LAN or the Hotwire RTU.

- *Pref* indicates the measurement of preference of one route to another, if you have two routes going to the same destination. (The lower the number the more preferable.) This route is compared to others for the same address.
- *S/D* indicates if the address in the *Host/Net* field is a source address or a destination address.
- *PA* (proxy ARP) indicates whether or not the DSLAM card or RTU answers ARP requests intended for another machine.

For more information about the routing table, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

MCC Card Static Route Example

The following illustration shows an example of the MCC card routing table.



MCC Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 135.1.3.4* 2) 0.0.0.0	255.255.255.255 0.0.0.0	135.1.3.1 135.1.2.1	dst (destination) dst (destination)

* This entry is automatically generated and does not need to be statically configured. The entry also automatically activates proxy ARP.

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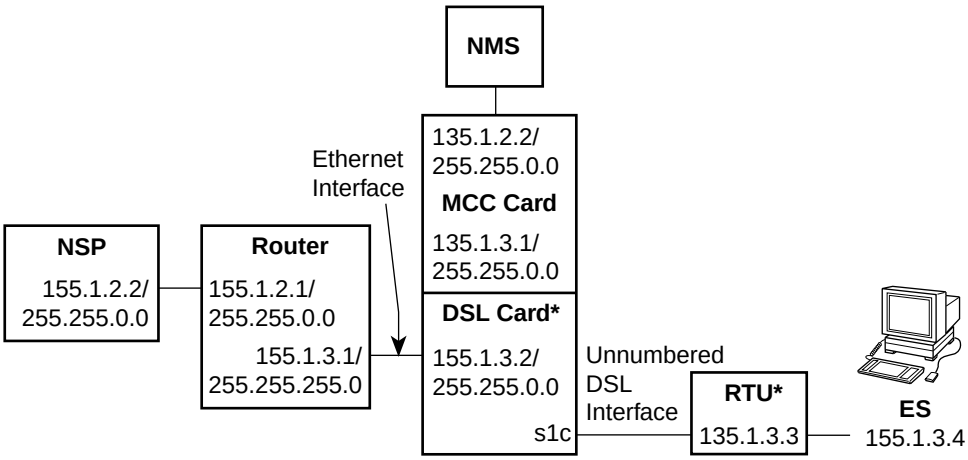
In this example, the IP address of the MCC card's management e1a IP address is 135.1.2.2.

- A packet being routed from the RTU to the NMS is routed using route #2 because no routes for the packet (i.e., destination 135.1.1.1) are specified. Therefore, the default route is used as the next hop address.
- A packet sent by NMS to the RTU is routed using route #1 because the destination IP address of the packet matches the route's Host/Net/Subnet entry (135.1.3.4). Therefore, the next-hop address would be the DSL card (135.1.3.1).

  Note also that the router is multihomed so that both the MCC card's and the DSL card's (management domain) subnetworks appear local (i.e., 135.1.2 and 135.1.3).

DSL Card Static Route Example

The following illustration shows an example of how static routes configured on a DSL card are used in its routing table:



*If DSL card is an 8540 DSL card, associated RTU will not have an IP address.

DSL Routing Table

Host/Net	Subnet Mask	8540 DSL Card Next-Hop Address	8546 DSL Card Next-Hop Address	S/D (Source/ Destination)	PA (Proxy ARP)
1) 155.1.3.4 2) 135.1.2.0 3) 0.0.0.0	255.255.255.255 255.255.255.0 0.0.0.0	s1c 135.1.3.1 155.1.3.1	135.1.3.3 135.1.3.1 155.1.3.1	dst (destination) dst (destination) dst (destination)	Y (yes) N (no) N (no)

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In this example:

- The DSL card's Ethernet port is connected to the router's port, which has an IP address of 155.1.3.1.

  Packets being routed in the upstream direction (to an NSP) would use the third routing table entry; i.e., *Host/Net* IP address 0.0.0.0 (by definition) and a *Next Hop* address of 155.1.3.1.

  They would use this route because no other destination would match.

- The management domain IP address of the RTU is 135.1.3.3 and the IP address of the ES is 155.1.3.4. Packets being routed downstream use the first routing table entry, i.e., *Host/Net* IP address of 155.1.3.4 and a *Next Hop* address of 135.1.3.3. Note that this is a host route.

- The second routing table entry is for upstream routing to the NMS via the MCC card. Note that this is a subnet route.

Dynamic Routes for Dynamic IP Addressing

Alternatively, NSPs can administer IP addresses to the end users dynamically (automatically) rather than statically (manually).

The dynamic IP addressing feature consists of the following components:

- **DHCP relay agent**

  The DSL card in the DSLAM acts as a DHCP relay agent. The DHCP relay agent is an intermediary function between the end-user system and the DHCP server. Its functions are to:

  — Detect and forward a DHCP request message from an end-user system to the appropriate DHCP server.

  — If you configure the system for optional authentication:

  1. Hold the DHCP request message.
  2. Send an authentication request to the authentication server in RADIUS or XTACACS format.
  3. Receive the authentication response. If negative, drop the held DHCP message. If positive, relay the held DHCP message to the DHCP server.

  — Track the end-user system dynamically allocated IP address and lease time from the DHCP acknowledgement by updating the routing table automatically.

- **Local host (DSLAM) route injection**

  The DSL card's routing table is used to determine the DSL port on which to forward incoming packets. This is achieved by examining the packet's destination IP address and comparing it to the list of IP addresses in the routing table. The subnet masks are set to 255.255.255.255 for host routes.

  The IP address and subnet mask are then used to determine the end-user system destination port. The DHCP relay agent adds (injects) the end-user system IP address and subnet mask into the routing table automatically.

- **Remote host (RTU) route injection (when using an 8546 DSL card and a 5446 RTU only)**

  The DSLAM also injects the end-user system's IP addresses into the 5446 RTU. The routing table in the 5446 RTU is used to determine if traffic on its 10BaseT (Ethernet) port is local or if it should be sent over the DSL. It determines this by checking if any of the addresses match the addresses in its local host routing table. This routing table is automatically updated by the 8546 DSL card after the DHCP relay agent has intercepted the end-user system's IP address in the DHCP reply message.

- **Automatic dynamic access control**

  The DSL card supports IP filters to validate user access to the NSP network. If the automatic dynamic access control feature is enabled, filters are configured automatically. The IP filters examine the IP source address of the upstream traffic to validate the end-user system's IP address. This feature enhances security by preventing an end user from spoofing the IP address of another user on a different DSL port. The DSLAM checks the end-user's IP address. If it does not match any valid IP addresses in the routing table, then the packet is dropped. Use the DHCP Relay Servers screen to enable this feature.

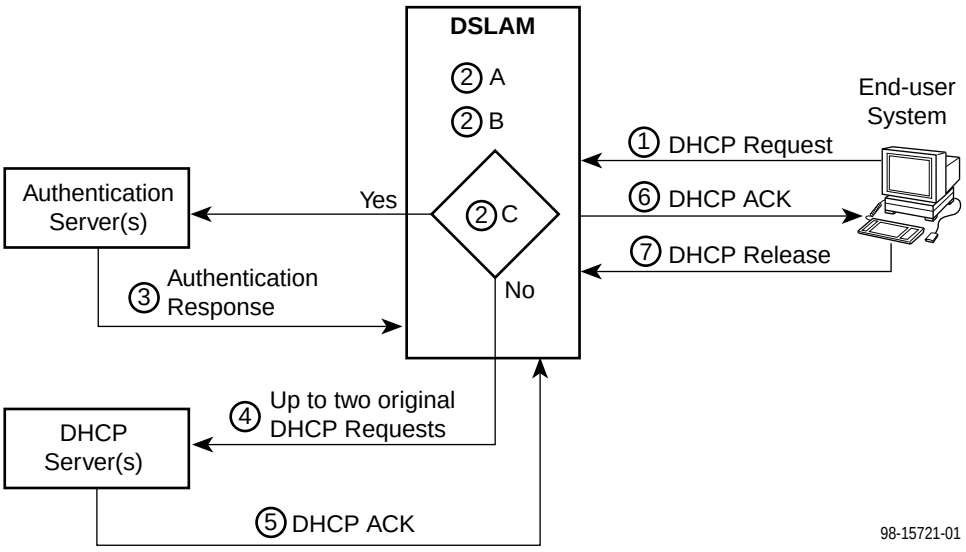
NOTE:

The DHCP server is typically maintained and operated by the NSP for its address domain. The Hotwire RTU routing tables and the DSLAM routing tables are automatically updated by the DSLAM.

Also, an RTU will not be able to obtain its address dynamically if the DHCP server assigns an address for which there is a static route (destination) already configured on the card.

How Does Dynamic IP Addressing Work?

The following illustration shows an example of a basic IP address request and assignment. This illustration assumes there are no problems associated with the request or assignment of the IP address.



1. The end-user system requests an IP address by broadcasting a DHCP request message to the DHCP server.
2. The DSLAM performs a DHCP relay by acting as a DHCP relay agent. The DHCP relay function of the DSLAM acts as an intermediary between the end-user system and the DHCP server, and works with DHCP servers that support structured subnetting. At this point, the following events occur:

   A. The DHCP relay within the DSLAM intercepts the end user's DHCP request for an address.

   B. If a domain name is detected, the DHCP relay determines if the domain has been configured to the DHCP server.

   C. It determines if authentication is required.

   If authentication is not required, it injects a gateway address into the message and forwards it to up to two DHCP servers.

   If authentication is required, the DSLAM sends the authentication message to the first authentication server. If no response is received, the message is sent to the second authentication server (using the same authentication type and same "Secret" as the first request).
3. An authentication response is received by the DSLAM. If the authentication is confirmed, the DHCP relay agent inserts the gateway address (i.e., the e1a IP address associated with the domain name) into the original DHCP request message.
4. The DSLAM forwards the message to up to two DHCP servers within the configured service domain.
5. The DHCP relay function of the DSLAM intercepts the DHCP ACK (acknowledge) message. At this point, the following events occur:

   — The DHCP relay agent extracts the IP address and lease time information from the DHCP ACK message.

   — The IP address is injected to the RTU (if the DHCP relay agent is an 8546 DSL card and the RTU is a 5446 RTU).

   — The DHCP relay agent injects the IP address, subnet mask of 255.255.255.255, lease time, and port number into the routing table. The routing tables are updated automatically.
6. After successful completion of these events, the DHCP ACK message is forwarded to the end user.
7. The IP addresses are automatically deleted from the DSLAM routing tables when the end user releases the IP address (by sending a DHCP release message) or the lease time expires without a renewal. Once the DHCP relay has deleted the configuration information, the end user will no longer be able to access the NSP.

   To regain access to the NSP, the end user must initiate a DHCP discover or request again to the DHCP server, and a new IP address will be assigned.

NOTE:

If an end user has a static configuration (that is, the user manually enters an IP address and the DSLAM and the RTU have a static host route), then the end user will not be allowed to obtain the same IP address via DHCP.

If an end user obtains an IP address via DHCP, then that IP address is bound to a particular DSL port (behind which the end user resides) on the DSLAM. In this case, the DSLAM will reject DHCP requests/renewals/releases for the same IP addresses from ports other than the one from which the IP address was bound.

General DHCP Relay Agent Configuration

To configure a DHCP relay agent, you must do the following:

1. Make sure that the gateway address used in relaying DHCP requests is configured as an e1a address on the IP Network screen (*Configuration→ Interfaces→ IP Network).*
2. Assign domain names to the e1a addresses that will be used as DHCP gateway addresses. Assign these domain names on the Domain Names screen (*Configuration→ DHCP Relay→ Domain Names*).
3. Configure the first four NSP domain names on the Servers 1–4 screen (*Configuration→ DHCP Relay Servers→ Servers 1–4*) and the remaining NSP domain names on the Servers 5–8, 9–12, and 13–16 screens.

   On the appropriate DHCP Relay Servers screen, you will need to enter up to two DHCP Server IP addresses for each domain. You will also need to determine whether or not you want to use the authentication feature. There are several fields that must be completed if you plan to use the authentication feature. In addition, you must also give the administrator of the authentication server some necessary information. See *Notes to the Authentication Server Administrator* for more information.

For detailed information about the various DHCP relay screens, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide.* Also Appendix A, *Network Configuration Worksheets*, in this guide provides worksheets to help you plan and record your network configurations for dynamic IP addressing.

Notes to the Authentication Server Administrator

If the authentication process is to be invoked as part of dynamic addressing, the authentication request from the DSLAM must be in either RADIUS or XTACACS format. The authentication server will receive an authentication request from the Hotwire DSLAM before the end-user's request for an address is relayed to the DHCP server.

NOTE:

The IP source address for these requests will be the e1a interface IP address associated with the domain.

The following sections describe the contents of the authentication request message for a RADIUS authentication server and an XTACACS authentication server.

RADIUS Authentication

If the authentication server is a RADIUS server, an Access-Request message will have the following format:

- The **`user_name`** will be the end-user's user ID as received by the DSLAM in the type 0 client ID field of the DHCP request.

  If the end-user request does not contain a user ID, the corresponding domain name is used as the **`user_name`**.

- The **`password`** will always be **`Hotwire.`**

  The passwords configured at the authentication server should not be set with an expiration time.

- The **`NAS-IP`** will be the DSL card's e1a address (gateway address) associated with this domain.

- The **`NAS-PORT`** will be the port number that received the end-user's request.

- The **`service type`** will be **`Authentication-Only.`**

- The **`RADIUS Secret`** value used for encryption is configured on the DHCP Relay Server screen.

The authentication request is sent to UDP port 1812 (as specified in RFC 2138).

If an **`Access-Accept`** message is returned, the DHCP request is relayed to the DHCP server.

XTACACS Authentication

If the authentication server is an XTACACS server, a Login message will have the following format:

- The **`user_name`** will be the end-user's user ID as received by the DSLAM in the type 0 client ID field of the DHCP request.

  If the end-user request does not contain a user ID, the corresponding domain name is used as the **`user_name`**.

- The **`password`** will be the e1a IP address (gateway address) associated with this domain in ASCII dotted decimal format.

  The passwords configured at the authentication server should not be set with an expiration time.

- The **`local_line`** will be the port number that received the end-user's request.

The authentication request is sent to UDP port 49 (as specified in RFC 1492).

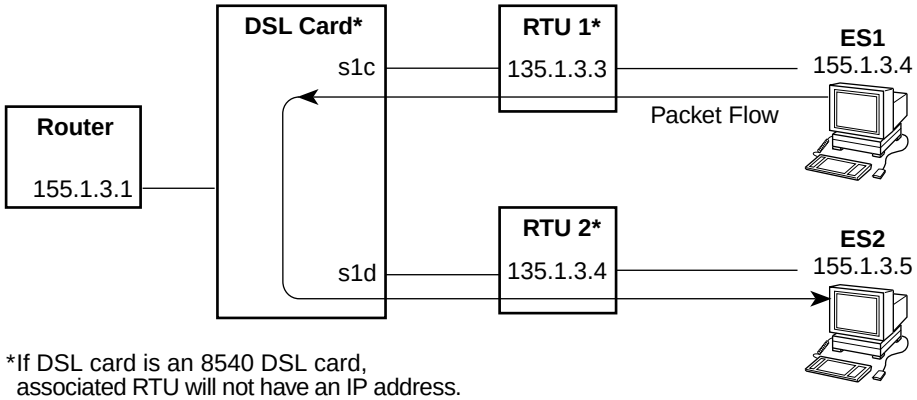
If the authentication request is successful, the DSLAM sends a **`LOGOUT`** message to the XTACACS server and the DHCP request is relayed to the DHCP server.

Source-Based Routing

In addition to destination-based routing, the Hotwire DSLAM system also supports source-based routing. **Source-based routing** is a security feature for preventing ES-to-ES routing when they are attached to different RTUs that are attached to the same DSL card. That is, sourced-based routing can ensure that all upstream traffic within a service domain is sent to the NSP.

Without Source-Based Routing

The following illustration shows that with destination routing ES1 can send packets to ES2 based on the static route table. That is, when ES1 sends a packet to ES2, the destination route is 155.1.3.5 and the next hop address for this destination is 135.1.3.4 (RTU 2).



*If DSL card is an 8540 DSL card, associated RTU will not have an IP address.

DSL Routing Table

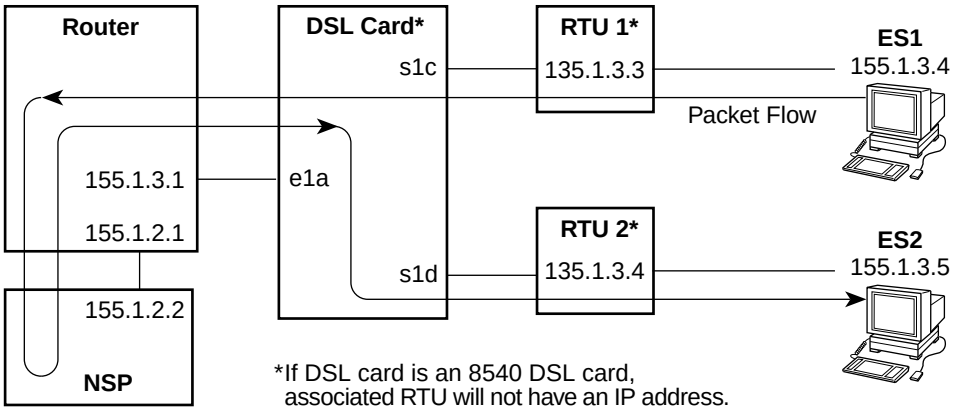
Host/Net	Subnet Mask	8540 DSL Card Next-Hop Address	8546 DSL Card Next-Hop Address	S/D (Source/ Destination)
1) 155.1.3.4 2) 155.1.3.5 3) 0.0.0.0	255.255.255.255 255.255.255.255 0.0.0.0	s1c s1d 155.1.3.1	135.1.3.3 135.1.3.4 155.1.3.1	dst (destination) dst (destination) dst (destination)

97-15472-02

With Source-Based Routing

With source-based routing, the source address of upstream packets sent from an ES are compared to the source address listed in the static route table. If a match is found, the packet is sent to the next-hop address specified for that source address.

The following illustration shows the packet flow when ES1 sends to ES2, and when source-based routes are defined for ES1 and ES2 (indicated by the S/D flag).



Partial DSL Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 155.1.3.4 2) 155.1.3.5	255.255.255.255 255.255.255.255	155.1.3.1 155.1.3.1	src (source) src (source)

97-15473-02

Upstream packets from ES1 (and ES2) are sent to 155.1.3.1, where in turn the router would forward them to the NSP. Downstream packets from the NSP are sent to ES2.

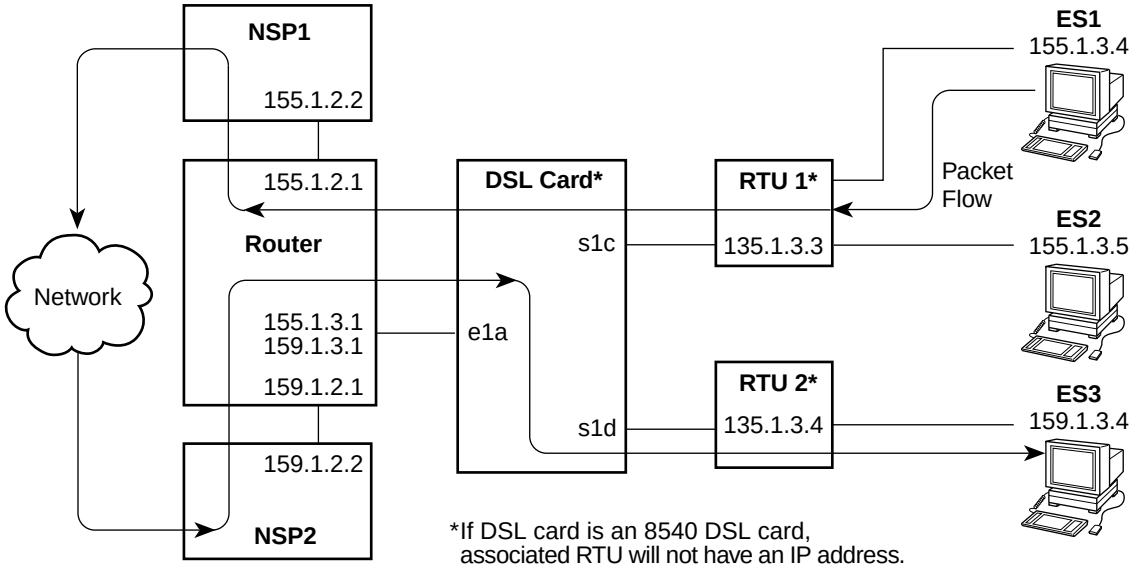
For upstream packets only (i.e., packets arriving over the DSL ports), the order of routing precedence is:

1. Source host route
2. Source subnet route
3. Source network route
4. Destination host route
5. Destination subnet route
6. Destination network route
7. Default route

NOTE:

When using source routing, do not use the default route.

The following illustration shows the packet flow when ES1 sends to ES3, ES1 and ES3 are in different service domains, and source-based routes are defined for ES1 and ES2 (indicated by the S/D flag).



Partial DSL Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 155.1.3.4 2) 155.1.3.5 3) 159.1.3.4	255.255.255.255 255.255.255.255 255.255.255.255	155.1.3.1 155.1.3.1 159.1.3.1	src (source) src (source) src (source)

97-15560-01

IP Filtering

7

Overview

A filter is a useful mechanism and can be used to:

- Secure a network by implementing security rules (policies).
- Prevent unauthorized network access without making authorized access difficult.

By default, filtering is not active on the Hotwire DSLAM system. However, you can enable filtering to selectively filter source or destination packets being routed through the MCC or DSL cards. Appendix B, *IP Filtering Configuration Worksheets*, provides worksheets to help you plan and record your filter configurations.

This chapter provides an overview of packet filters and describes why you may want to set filters on your network.

What is a Filter?

An **IP filter** is a rule (or set of rules) that is applied to a specific interface to indicate whether a packet can be forwarded or discarded.

A filter works by successively applying its rules to the information obtained from the packet header until a match is found. (Host rules have precedence over network rules.) The filter then performs the action specified by the rule on that packet, which can be either to forward or discard. If the packet header information does not match any of the rules, then the user-specified default filter action is performed. The filter does not change any state or context, and the decision is made based only on the packet contents.

NOTE:

If your system is set up for dynamic IP addressing and you have enabled the dynamic access control feature, you do not need to configure filters because this is done automatically. However, you will need to bind the filters to the appropriate interface if you have unbound them. The dynamic access control feature is configurable on the DHCP Relay Servers screen. See Chapter 5, *DSL Card Configuration*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide* for more information.

You can create the following filter types:

- An **input filter** to prevent packets entering the DSL card through a specified interface from being forwarded. You may want to set up filtering on input to protect against address spoofing. Use the IP Network screen (*Configuration* → *Interfaces* → *IP Network*) to specify binding of an input filter to a particular interface.
- An **output filter** to prevent packets from going out of the DSL card through a specified interface. Use the IP Network screen (*Configuration* → *Interfaces* → *IP Network*) to specify binding of an output filter to a particular interface.

For each filter type, you must set up one or more of the following rule types on the IP Filter Configuration screen (*Configuration* → *IP Router* → *IP Router Filters*):

- A **network address rule type** to discard or forward packets/traffic from a specified network or a segment of the network. This rule type can also be used to enhance security by allowing access only to certain networks. The IP address and subnet mask specified in the **`Destination address`** and **`Destination address mask`** fields, or the **`Source address`** and **`Source address mask`** fields of the IP Filter Configuration screen are compared to the destination/source address contained in the IP header of the packet.
- A **host address rule type** to discard or forward packets/traffic from a specified host. This rule type can also be used to enhance security by allowing access only to certain hosts. The IP address and subnet mask specified in the **`Destination address`** and **`Destination address mask`** fields, or the **`Source address`** and **`Source address mask`** fields of the IP Filter Configuration screen are compared to the destination/source address contained in the IP header of the packet.

  NOTE:

  Host address rules have precedence over network address rules. All host address rules will be invoked sequentially before the first network address rule is invoked.

- A **socket address rule type** to limit certain applications. This rule type is used primarily when filtering TCP or UDP packets, and may be used in conjunction with a network address rule type or a host address rule type. The destination (socket) port number specified in the **`Destination Port No.`** field and source (socket) port number specified in the **`Source Port No.`** field of the IP Filter Configuration screen are compared to the destination and source port numbers in the TCP or UDP header of the packet.

  NOTE:

  If both the source and destination port numbers are 0s (zeros), the system filters ICMP packets in addition to the packet types defined in the rule.

In this release, you can configure up to two filters on the MCC card and up to eight filters on each DSL card. Also, up to 33 rules can be configured for each filter. Keep in mind that for each filter, you will need to configure the default filter action (either to forward or discard packets).

For detailed information on the IP Filter Configuration screen and the IP Network screen, see Chapter 5, *DSL Card Configuration* and Chapter 6, *Monitoring the Hotwire DSLAM*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Security Advantages

Filtering provides security advantages on LANs as described in the following subsections.

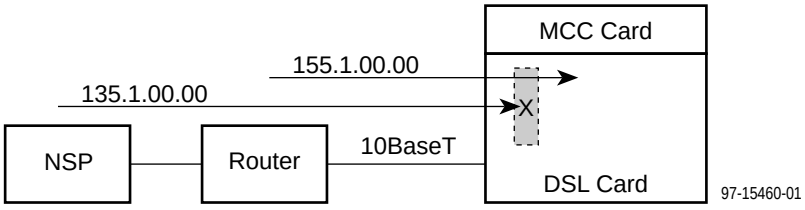
NOTE:

All upstream traffic from an ES is forwarded by a Hotwire 5246 or 5446 RTU to the DSL card unless it is addressed to another ES (in the same subnet) on the same LAN.

Management Traffic Leakage

Filtering can be used to prevent unwanted traffic from leaking into the management domain. That is, filtering prevents NSP packets with management IP destinations from being accepted for local delivery or routing.

For example, if the NSP network is 155.1.00.00 and the management network is 135.1.00.00, filters can be defined that would prevent any traffic entering from the 10BaseT port from being forwarded to the 135.1.00.00 network through the DSL card.



NOTE:

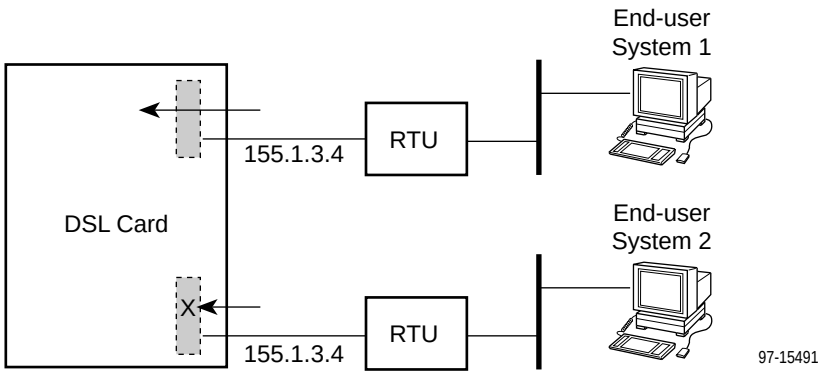
Filters reduce packet throughput.

For instructions on how to set filters to prevent unwanted traffic from leaking into the management domain, see Chapter 5, *DSL Card Configuration*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Service Security

Filtering on the upstream DSL ports can be used to ensure that only end-user systems with valid IP addresses are able to route traffic to the service domain. That is, filtering would block traffic from being routed upstream by another end-user system that spoofs (attempts to gain access to another system by posing as an authorized user) an IP address of an end-user system connected to a different Hotwire RTU.

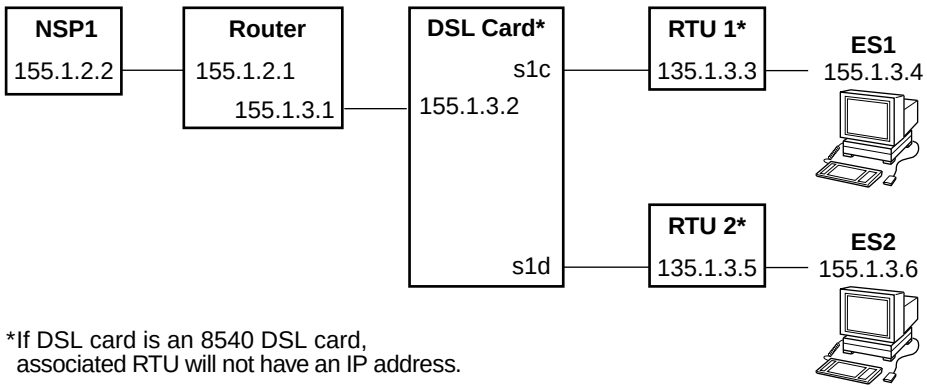
The following illustration is an example of this type of filtering:



For information on how to set filters on the upstream DSL ports, see Chapters 5 and 6 of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Service Security Filtering Scenario

The following is an example of filtering to ensure service security:



*If DSL card is an 8540 DSL card, associated RTU will not have an IP address.

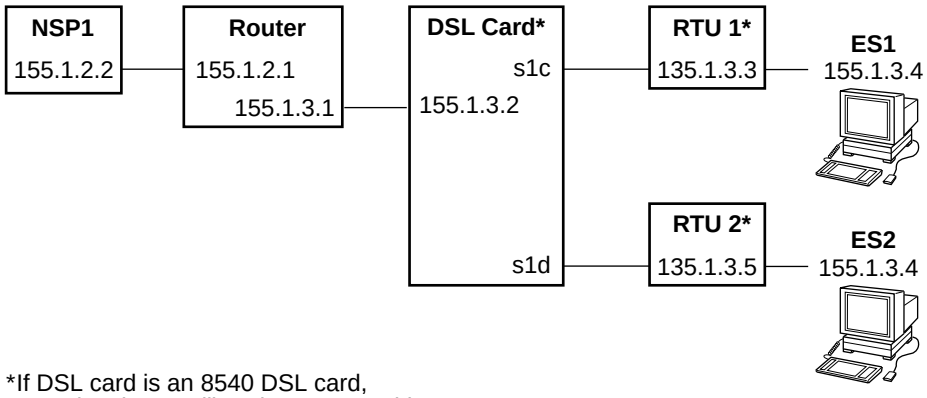
DSL Routing Table

Host/Net	Subnet Mask	8540 DSL Card Next-Hop Address	8546 DSL Card Next-Hop Address	S/D (Source/ Destination)
1) 155.1.3.4	255.255.255.255		155.1.3.1	src (source)
2) 155.1.3.4	255.255.255.255	s1c	135.1.3.3	dst (destination)
3) 155.1.3.6	255.255.255.255		155.1.3.1	src (source)
4) 155.1.3.6	255.255.255.255	s1d	135.1.3.5	dst (destination)

97-15476-02

The RTU forwards upstream any traffic on its LAN interface for which it does not know the host.

In the following illustration, ES2 spoofs ES1's IP address (that is, ES2 assumes ES1's IP address of 155.1.3.4):



*If DSL card is an 8540 DSL card, associated RTU will not have an IP address.

ES2 spoofing ES1's address

DSL Routing Table

Host/Net	Subnet Mask	8540 DSL Card Next-Hop Address	8546 DSL Card Next-Hop Address	S/D (Source/ Destination)
1) 155.1.3.4 2) 155.1.3.4 3) 155.1.3.6 4) 155.1.3.6	255.255.255.255 255.255.255.255 255.255.255.255 255.255.255.255	155.1.3.1 s1c 155.1.3.1 s1d	155.1.3.1 135.1.3.3 155.1.3.1 135.1.3.5	src (source) dst (destination) src (source) dst (destination)

97-15477-02

With no input filtering on the DSL ports, ES2 can successfully send traffic to the NSP identifying itself as ES1 (155.1.3.4).

Now, consider that the following filter rules are applied to s1d:

IP Address	Subnet Mask	Source/Destination	Action
155.1.3.6	255.255.255.255	Source	Forward
Default	—	—	Discard

With these filter rules active on s1d, when ES2 tries to send packets to ISP1, the filter on the DSL card blocks the packets from being forwarded, because only packets with a source IP address of 155.1.3.6 are forwarded.

SNMP Agent

8

Overview

The Simple Network Management Protocol (SNMP) is an application-level protocol used in network management. A Network Management System (NMS), such as Paradyne's OpenLane DCE Manager, communicates to an SNMP agent via SNMP in order to obtain (get) specific parameters or variables within control of the SNMP agent.

When DCE Manager is configured properly, it can communicate with the Hotwire DSLAM SNMP agent. Almost all communications between the DCE Manager and the Hotwire DSLAM SNMP agent originate with a request message from the DCE Manager to the Hotwire DSLAM. When the DSLAM receives the request, the Hotwire DSLAM SNMP agent processes the request message and transmits a response (positive or negative) message back to the DCE Manager. When certain significant events occur within the SNMP agent, this can result in transmission of unprompted SNMP trap messages to the DCE Manager. (Note that the Hotwire DSLAM SNMP agent is SNMP Version 1 (V1) compliant with community-based management.)

This chapter describes what you need to know to configure the SNMP agent within the Hotwire DSLAM. This chapter does not, however, describe the procedures on how to configure the SNMP agent. For those procedures, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

MIB Compliance

Various pieces of configuration, status, and statistical data within the Hotwire DSLAM SNMP agent form a database of information that is accessible from the DCE Manager. This collection of information is called a Management Information Base (MIB). The basic definitions of the content of an SNMP agent's MIB are defined within various Internet Request for Comments (RFC) documents.

An HP OpenView MIB browser requires the operator to load the appropriate MIB files into its database before it can manage the Hotwire DSLAM network. For more information about DCE Manager, see the *OpenLane DCE Manager for HP OpenView for Windows User's Guide* or the *OpenLane DCE Manager User's Guide*.

The Hotwire DSLAM supports the following MIBs:

- MIB II – System Group (described in RFC 1213)
- MIB II – ICMP Group (described in RFC 1213)
- MIB II – UDP Group (described in RFC 1213)
- MIB II – Transmission Group (described in RFC 1213)
- MIB II – SNMP Group (described in RFC 1213)
- MIB II – Definitions of Managed Objects for the Ethernet-like Interface Types (described in RFC 1398)
- MIB II – Definitions of Managed Objects for the Link Control Protocol of the Point-to-Point Protocol (described in RFC 1471)
- MIB II – Definitions of Managed Objects for the IP Network Control Protocol of the Point-to-Point Protocol (described in RFC 1473)
- MIB II – Evolution of Interfaces Group (described in RFC 1573)
- MIB II – Ethernet Interface MIB (described in RFC 1643)
- Entity MIB (described in RFC 2037)
- Paradyne DSL Enterprise MIBs:
  - Hotwire System MIB (hot_sys.mib)
  - Hotwire xDSL MIB (hot_xdsl.mib)
  - Security MIB (devSecurity.mib)
  - Device Health and Status MIB (devHealthAndStatus.mib)
  - DHCP Relay Agent MIB (hot_dhcp.mib)
  - Hotwire 5446 RTU Traps MIB (trapdefs.mib)
  - Diagnostics MIB (hot_diag.mib)
  - IP Injection MIB (injection.mib)

Supported Traps

SNMP defines six basic or standard traps. These messages are identified with a value of 0 through 5 within the generic-trap field of the trap message. (Note that the Hotwire DSLAM SNMP agent does not support trap messages with a value of 5.) The specific-trap field of standard trap messages is set to 0 (zero). The specific-trap field of enterprise-specific messages defines the trap.

The Hotwire DSLAM SNMP agent supports generation of the following standard trap messages (specific-trap=0):

- **coldStart(0) –** The sending SNMP agent reinitializes itself such that the agent's configuration may be altered.
- **warmstart(1) –** The sending SNMP agent is reinitialized without altering the agent's configuration.
- **linkDown(2) –** A link on the sending SNMP agent is no longer operational.
- **linkUp(3) –** A link on the sending SNMP agent has become operational.
- **authenticationFailure(4) –** The sending SNMP agent has received an SNMP message specifying a community name which it does not recognize, or requesting an action not permitted for the specified community.

There are additional Hotwire Enterprise supported traps, which can be found in the Paradyne DSL Enterprise MIBs. See the MIBs for a complete list of traps. MIBs can be accessed through the Paradyne Power Pages (*www.paradyne.com*). Select: *Service & Support → MIBs → Hotwire DSL → pdndce.mib*

The generation of SNMP trap messages can be selectively enabled per configured community. Additionally, the authenticationFailure trap can be selectively enabled for all configured communities that have traps enabled. If any communities have the generation of trap messages enabled, then the generation of authenticationFailure traps is determined by the state of the global authenticationFailure switch.

General SNMP Agent Configuration

Depending on your specific network configuration, various aspects of the Hotwire DSLAM SNMP agent may need to be configured. For example, you may want to set up your system to send SNMP traps to a specific SNMP NMS manager. The Hotwire DSLAM system provides four default community names (two read/write community names and two read-only community names) per MCC or DSL card. These community names are similar to passwords.

Make sure that the SNMP NMS manager that will receive SNMP trap messages knows and uses the correct community name, as specified on the Hotwire DSLAM. You can change the default community names to match the name of the SNMP NMS manager. Without the correct community name, the NMS manager will not be able to communicate with the DSLAM.

As a minimum configuration, you must do the following on the SNMP Communities/Traps screen in order for an NMS to receive SNMP traps:

- Assign an SNMP NMS manager to a R/W (Read-Write) or R/O (Read-only) community by specifying the SNMP NMS manager's IP address. You can specify up to three SNMP NMS managers for each community name.
- Configure the generation of trap messages by specifying E (for Enable) on the SNMP Communities/Traps screen.
- Enable/Disable the generation of authenticationFailure trap messages.

To enable the set capability, the NMS manager needs the correct Read/Write (R/W) community name. If security is enabled, the NMS manager's IP address must be specified with R/W privileges on the SNMP Security screen. This applies to both the MCC and DSL card SNMP security menus.

For detailed information about the various SNMP Agent screens mentioned in this chapter, see Chapter 5, *DSL Card Configuration*, and Chapter 6, *Monitoring the Hotwire DSLAM*, of the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*. Also Appendix C, *SNMP Configuration Worksheets*, in this guide provides worksheets to help you plan and record your SNMP configurations.

NOTE:

The Hotwire RTUs that operate with the 8540 DSL card do not have their own SNMP agent. Therefore, limited SNMP support is provided by the 8540 DSL card in the DSLAM (limited support including remote system object ID, remote system description, and remote system services).

To configure RTU information for an 8540 DSL card, use the Hotwire DSLAM user interface (RTU Config screen). On this screen, you can enter the RTU type, system name, contact, and location. For detailed information, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Packet Walk-Throughs

9

Overview

This chapter provides examples of how data packets are routed through the service and management domains.

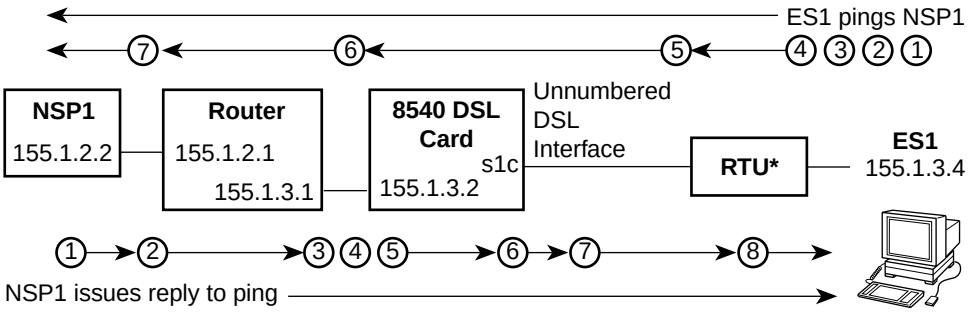
Packet Walk-Through Using an 8540 DSL Card

Service Domain Packet Walk-Through

To examine how data packets flow through the service domain, an example of ES1 issuing a ping to NSP1 will be used. The following assumptions are made:

- A source domain IP entry exists for ES1
- A static route exists between the DSL card and ES1
- Filtering is disabled

The following illustration shows how data packets flow through the service domain. In this illustration ES1 is connected to the same LAN as the Hotwire RTU.



* The RTU can be a 5170, 5171, 5216, or 5246 RTU.

Partial DSL Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 155.1.3.4 2) 155.1.3.4	255.255.255.255 255.255.255.255	155.1.3.1 s1c	src (source) dst (destination)

97-15474-02

When ES1 pings NSP1:

1. ES originates a packet addressed to 155.1.2.2. Because they are both on the 155.1 network, ES1 ARPs to map NSP1's IP address into a MAC address.
2. The RTU forwards the ARP to the 8540 DSL card over its DSL interface (e.g., s1c).
3. The 8540 DSL card replies to the ARP request with its own MAC address (proxy ARP).
4. After ES1 receives the ARP reply, it sends the packet to the MAC address of the 8540 DSL card.
5. Upon receiving this packet, the RTU forwards it to the 8540 DSL card over its DSL interface.
6. When the 8540 DSL card receives this packet, the 8540 DSL card consults its routing table to determine how to route the packet. Since a source route is defined for ES1 (route #1), the 8540 DSL card forwards the packet to the router (151.1.3.1), which is the next hop.
7. The router then forwards the packet to NSP1.

NSP1 then issues a reply to the ping.

1. The NSP sends the ping reply packet addressed to 155.1.3.4.
2. By normal means, the packet arrives at the router.
3. Because the router has an interface with an address 155.1.3.1 (on 155.1.3 subnet), it ARPs for 155.1.3.4.
4. Because the 8540 DSL card has a host route (marked PA=y) for 155.1.3.4, it responds to the ARP request with its own MAC address (proxy ARP).
5. Then, the ping reply is sent directly to the 8540 DSL card.
6. The 8540 DSL card then consults its routing table to identify the next hop to forward the packet. Since a host route is defined for ES1 (route #2), the DSL interface is used as the next hop.
7. The 8540 DSL card then forwards the packet over the DSL port to that RTU.
8. Upon receiving the packet, the RTU forwards the packet to its 10BaseT port.

Management Domain Packet Walk-Through

For an 8540 DSL card and its associated RTUs, all management functions are performed by an agent on the DSL card.

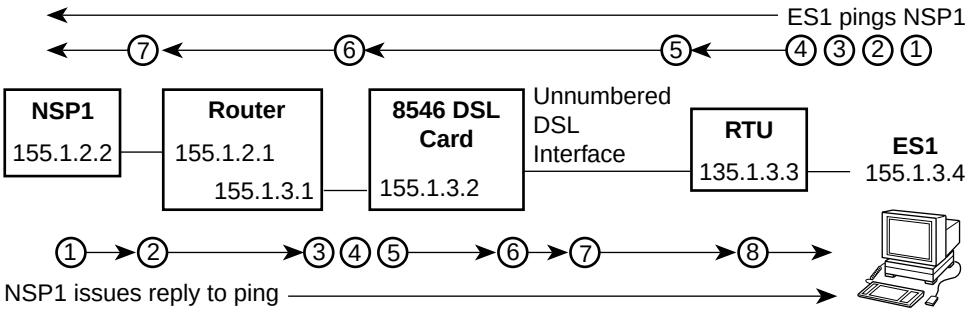
Packet Walk-Through Using an 8546 DSL Card

Service Domain Packet Walk-Through

To examine how data packets flow through the service domain, an example of ES1 issuing a ping to NSP1 will be used. The following assumptions are made:

- A host route entry has been configured in the Hotwire RTU for ES1
- A source domain IP entry exists for the Hotwire RTU
- A static route exists between the 8546 DSL card and the Hotwire RTU
- Filtering is disabled

The following illustration shows how data packets flow through the service domain. In this illustration ES1 is connected to the same LAN as the Hotwire RTU.



Partial DSL Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 155.1.3.4 2) 155.1.3.4	255.255.255.255 255.255.255.255	155.1.3.1 135.1.3.3	src (source) dst (destination)

97-15474a

When ES1 pings NSP1:

1. ES originates a packet addressed to 155.1.2.2. Because they are both on the 155.1 network, ES1 ARPs to map NSP1's IP address into a MAC address.
2. The RTU receives the broadcast ARP request from ES1.
3. The RTU replies to the ARP request with its own MAC address (proxy ARP).
4. After ES1 receives the ARP reply, it sends the packet to the MAC address of the RTU.
5. Upon receiving this packet, the RTU forwards it to the 8546 DSL card over its DSL interface.
6. When the 8546 DSL card receives this packet, the 8546 DSL card consults its routing table to determine how to route the packet. Since a source route is defined for ES1 (route #1), the 8546 DSL card forwards the packet to the router (151.1.3.1), which is the next hop.
7. The router then forwards the packet to NSP1.

NSP1 then issues a reply to the ping.

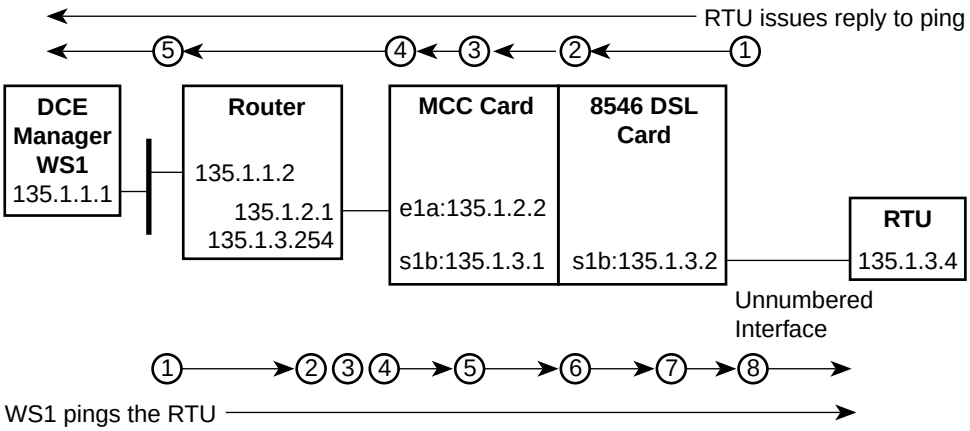
1. The NSP sends the ping reply packet addressed to 155.1.3.4.
2. By normal means, the packet arrives at the router.
3. Because the router has an interface with an address 155.1.3.1 (on 155.1.3 subnet), it ARPs for 155.1.3.4.
4. Because the 8546 DSL card has a host route (marked PA=y) for 155.1.3.4, it responds to the ARP request with its own MAC address (proxy ARP).
5. Then, the ping reply is sent directly to the 8546 DSL card.
6. The 8546 DSL card then consults its routing table to identify the next hop to forward the packet. Since a host route is defined for ES1 (route #2), the RTU 135.1.3.3 is used as the next hop.
7. The 8546 DSL card then forwards the packet over the DSL port to that RTU.
8. Upon receiving the packet, the RTU forwards the packet to its 10BaseT port because it has a host route for ES1.

Management Domain Packet Walk-Through

To examine how data packets flow through the management domain, an example of the DCE Manager workstation 1 (WS1) performing a ping to the Hotwire RTU is used. The following is assumed:

- A host route to the RTU (135.1.3.4) exists on the MCC card. (This is generated automatically.)
- A static route to WS1 (135.1.1.1) is configured on the 8546 DSL card.

In the following illustration, WS1 is connected to the same LAN as the NMS.



MCC Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 135.1.3.4 2) 0.0.0.0	255.255.255.255 0.0.0.0	135.1.3.2 135.1.2.1	dst (destination) dst (destination)

Partial DSL Routing Table

Host/Net	Subnet Mask	Next-Hop Address	S/D (Source/Destination)
1) 135.1.2.0 2) 135.1.1.0 3) 135.1.3.4	255.255.255.0 255.255.255.0 255.255.255.0	135.1.3.1 135.1.3.1 135.1.3.4	dst (destination) dst (destination) dst (destination)

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When WS1 pings a Hotwire RTU:

1. The packet addressed to 135.1.3.4 is routed to the router by normal means.
2. The router then does an ARP request for the RTU because the router's IP address of 135.1.3.254 is on the same subnetwork as the RTU (with an IP address of 135.1.3.4).

   Note that the router's interface to the MCC is multihomed (i.e., it has two IP addresses (135.1.2.1 and 135.1.3.254) assigned to the one interface).
3. The MCC does an ARP reply with its own MAC address (proxy ARP).
4. The router then forwards the ping packet to the MCC card.
5. Upon receiving the ping, the MCC card consults its routing table to identify to which 8546 DSL card to forward the ping.

   In this case, route #1 contains a host route for 135.1.3.4 with a next hop of DSL 135.1.3.2.
6. The ping request is then forwarded to the 8546 DSL card from the MCC card's *s1b* interface to the 8546 DSL card's *s1b* interface (which is over the DSLAM system backplane).
7. From the routing table, the 8546 DSL card determines that 135.1.3.4 is directly connected over s1c (one of the 8546 DSL card's DSL ports).
8. The 8546 DSL card then forwards the ping to the RTU over s1c.

The Hotwire RTU then issues a ping reply to IP address 135.1.1.1.

1. The RTU forwards the ping reply to the 8546 DSL card.
2. The 8546 DSL card consults its routing table to identify how to forward the reply. Route #2 is used because the destination address (135.1.1.1) is the 135.1.1 subnet. Therefore, the next-hop address is the MCC card's *s1b* interface (135.1.3.1).
3. Similarly, upon receiving the packet, the MCC card consults its routing table to identify how to forward the packet. Since the destination IP address of the ping is WS1 (135.1.1.1) and this does not match any entry in the route table, the next-hop IP address (135.1.2.1) of the default route is used.
4. The MCC card then forwards the packet to its 10BaseT interface to the router.
5. The router forwards the packet toward WS1 by normal means.

Network Configuration Worksheets

A

Overview

This appendix summarizes the minimum configuration steps and provides worksheets to assist you in preparing for the configuration of your Hotwire DSLAM network. Use the worksheets to record configuration settings such as IP addresses and subnet masks for the MCC card, DSL cards, and RTUs. After the worksheets are completed, you can then configure your network with the assigned settings.

These worksheets are based on the network model and theories described in this guide. They map the network theories to the Hotwire user interface screens. For an explanation of the network model and theories, review the chapters in this guide. For specific information about the user interface screens and fields, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Summarizing the Network Configuration

In summary, to configure the network:

- The management domain and service domain IP addresses and static routes are assigned to the Hotwire DSLAM system using the Hotwire user interface.
- If using a Hotwire 5446 RTU, the RTU's management IP address is also assigned from the Hotwire user interface. In addition, the service domain IP addresses and host routes on the Hotwire 5446 RTU are assigned by using the DSL Configuration RTU screens.
- The IP addresses of the end-user systems are assigned by the NSP.

Management Domain Configuration Worksheets

For the management domain, configure the MCC card, DSL cards, and Hotwire 5446 and 5546 RTUs as follows:

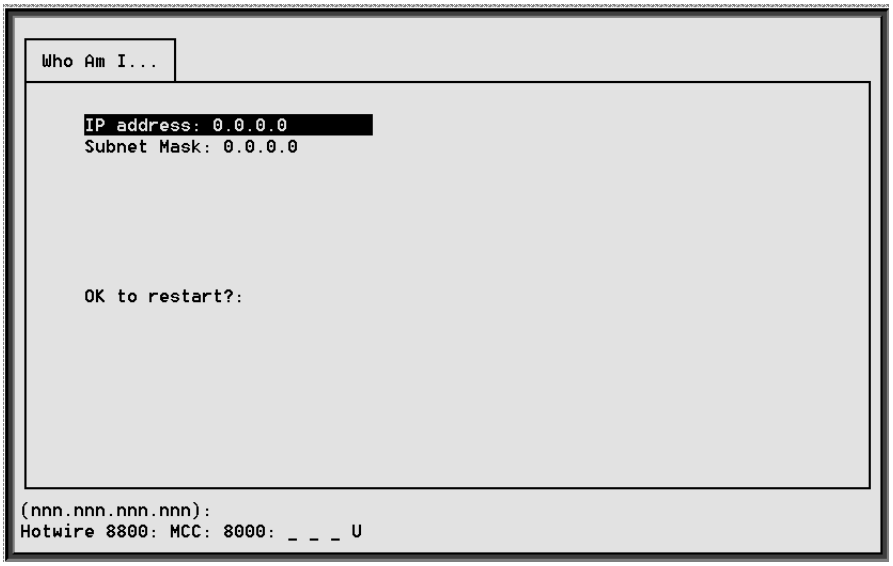
Perform this task . . .	On this screen . . .	To access the screen . . .
1. Assign an IP address to the MCC card. (See page A-3.)	Who Am I	Power on the Hotwire DSLAM system. The system displays the Who Am I screen.
2. Clear NVRAM if the Who Am I screen does not appear in Task 1. (See page A-5.)	(Hotwire – MCC) NVRAM Clear	From the Hotwire – MCC menu, select: *Configuration → Card Status → NVRAM Clear*
3. Assign an IP address to the backplane (s1b) on the MCC card. (See page A-6.)	(Hotwire – MCC) IP Network	From the Hotwire – MCC menu, select: *Configuration → Interfaces → IP Network*
4. Assign IP addresses to the DSL cards. (See page A-7.)	(Hotwire – MCC) Configure DSL IP Addr	From the Hotwire – MCC menu, select: *Configuration → DSL Cards → Set IP Address*
5. Create a default route to the upstream router in the management domain. (See page A-9.)	(Hotwire – MCC) Static Routes	From the Hotwire – MCC menu, select: *Configuration → IP Router → Static Routes*
6. Reset the MCC card. (See page A-11.)	(Hotwire – MCC) Card Reset	From the Hotwire – MCC menu, select: *Configuration → Card Status → Card Reset*
7. (When Using an 8546 DSL Card) Assign an IP address within the management subnetwork for each Hotwire 5446 RTU or router connected to a 5546 RTU. (See page A-12.)	(Hotwire – DSL) IP Network	From the Hotwire – DSL menu, select: *Configuration → Interfaces → IP Network*
8. Configure a static route to an NMS (on each DSL card). (See page A-14.)	(Hotwire – DSL) Static Routes	From the Hotwire – DSL menu, select: *Configuration → IP Router → Static Routes*

Use the worksheets in the following sections to record your network configuration settings. Photocopy the worksheets as needed.

TASK 1: Assign an IP Address to the MCC Card

On the Who Am I screen, assign an IP address to the MCC card.

Access the . . .	By . . .
Who Am I screen	Powering on the Hotwire DSLAM system.



Who Am I Screen	
Prompt	**Your Configuration Setting**
1. Enter the IP address to the MCC card (e1a) at the **(nnn.nnn.nnn.nnn):** prompt. **NOTE:** If you enter two consecutive dots (.) in the IP address, the system will interpret this as dot-zero-dot (.0.).	IP Address =
2. Enter the subnet mask at the **(nnn.nnn.nnn.nnn):** prompt. Note that the system automatically calculates the subnet mask. Press Return to accept the default value or enter a new value at the prompt.	Subnet Mask =
3. Reboot the system by typing **yes** at the **yes/no:** prompt, when the system highlights **OK to restart?**.	

NOTE:

To continue configuring the management domain, you must select the MCC card.

After the system reboots, press Return to display the Hotwire Chassis menu.

— From the Hotwire Chassis menu, select Card Selection.

The Card Selection screen appears.

— At the **Goto Card (M for MCC or slot# for DSL):** prompt, enter **M** and press Return.

The Hotwire – MCC menu appears.

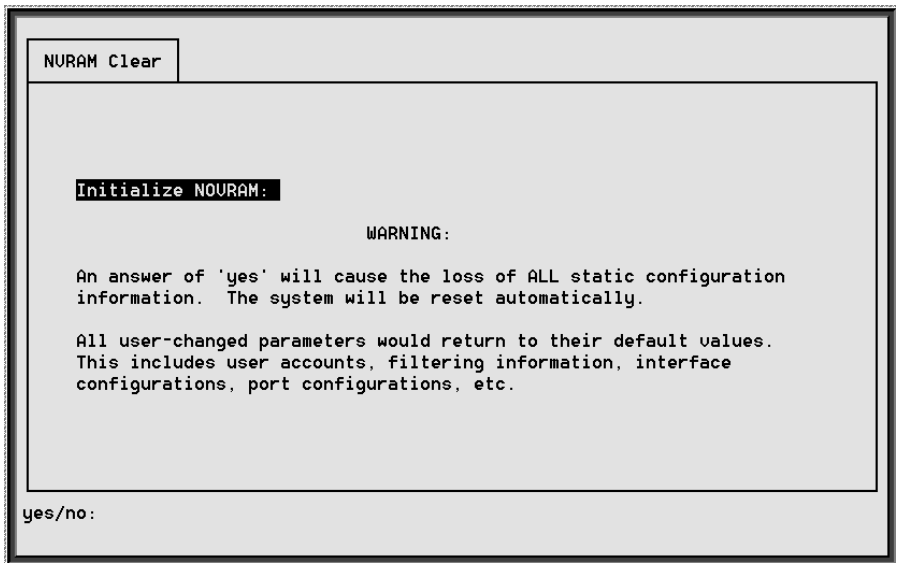
TASK 2: Clear NVRAM

On the Clear NVRAM screen, clear the non-volatile RAM if the Who Am I screen does not appear after power up (in Task 1) by entering **yes** at the **`Initialize NVRAM: yes/no`** prompt.

NOTE:

An answer of **yes** causes the loss of all static configuration information. Any changed parameters will return to default values, including user accounts, filtering information, interface configurations, and port configurations.

Access the . . .	**By . . .**
Clear NVRAM screen	Selecting *Configuration* → *Card Status* → *NVRAM Clear* from the Hotwire – MCC menu.



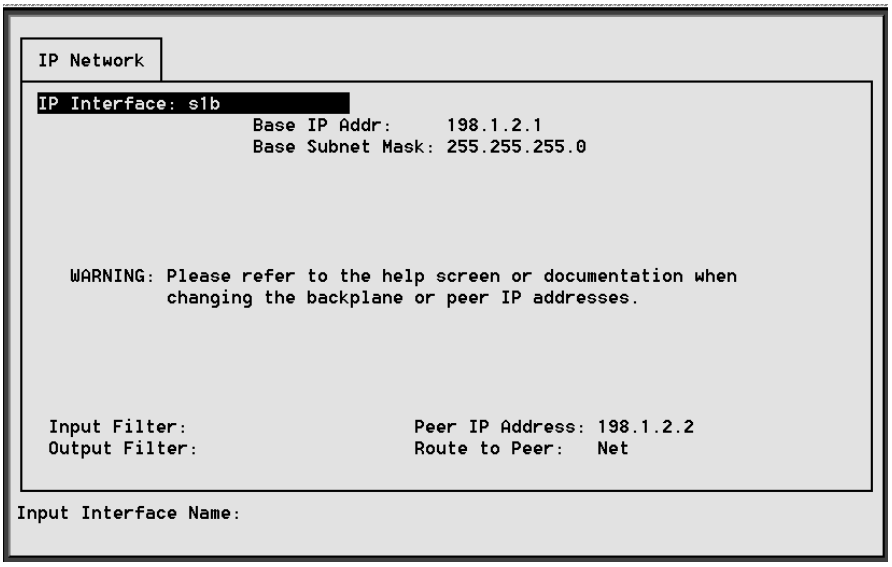
TASK 3: Assign an IP Address to the Backplane (s1b)

On the IP Network screen, assign an IP address to the backplane (s1b).

NOTE:

You will need to create a separate and distinct network or subnetwork for the 8546 DSL cards and 5446 RTUs, or for 8540 DSL cards. However, the RTUs associated with the 8540 DSL cards are not included in the network. Also, if you enter two consecutive dots (.) in the IP address, the system will interpret this as dot-zero-dot (.0.).

Access the . . .	By . . .
IP Network screen	Selecting *Configuration* → *Interfaces* → *IP Network* from the Hotwire – MCC menu.



IP Network Screen	A-C-B
Prompt	**Your Configuration Setting**
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **s1b**
2. Enter the base IP address at the **`(nnn.nnn.nnn.nnn):`** prompt.	Base IP Addr =
3. Enter the base subnet mask at the **`(nnn.nnn.nnn.nnn):`** prompt.	Base Subnet Mask =
4. Enter the peer IP address at the **`(nnn.nnn.nnn.nnn)`** or **`address-pool:`** prompt.	Peer IP Address =
5. Enter route type **NET** (for network) at the **`Route to peer (host/net):`** prompt.	Route to Peer= **NET**

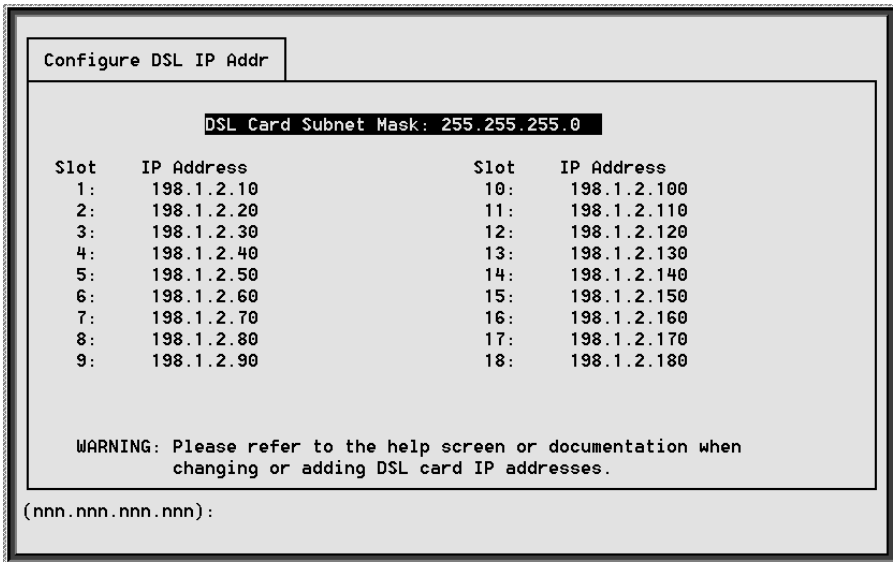
TASK 4: Assign IP Addresses to the DSL Cards

On the Configure DSL IP Addr screen, assign an IP address to each DSL card in the system.

NOTE:

If you enter two consecutive dots (.) in the IP address, the system will interpret this as dot-zero-dot (.0.).

Access the . . .	**By . . .**
Configure DSL IP Addr screen	Selecting *Configuration* → *DSL Cards* → *Set IP Address* from the Hotwire – MCC menu.

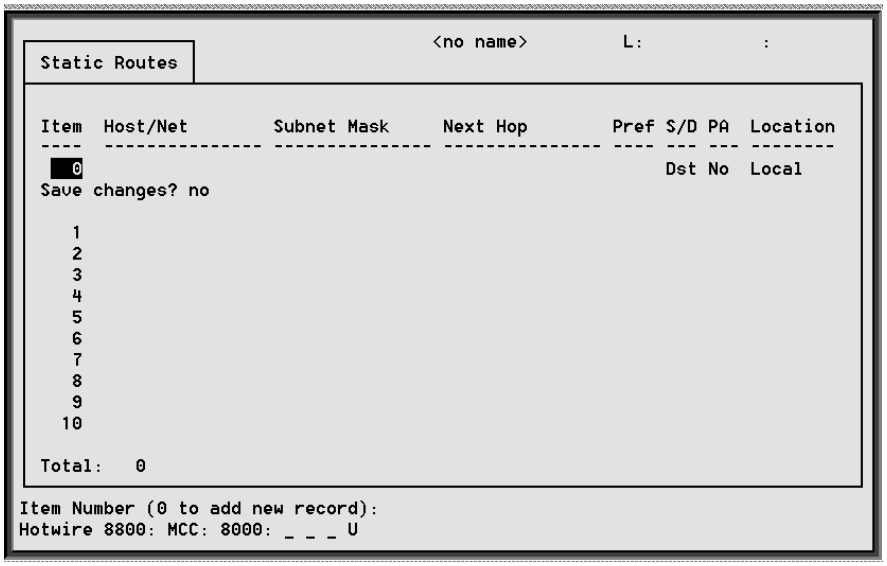


Configure DSL IP Addr Screen	A-G-A
Prompt	**Your Configuration Setting**
1. Enter the DSL card subnet mask at the **(nnn.nnn.nnn.nnn):** prompt. This must be the same as the subnet mask for the backplane (s1b) management subnet.	DSL Card Subnet Mask = (Read-only in future release.)
2. Enter the IP address for each DSL card in the system. Select the appropriate slot number by using the arrow keys to move from one field to another. Once the slot number is selected, enter the IP address for that DSL card at the **(nnn.nnn.nnn.nnn):** prompt.	Slot 1 IP Address = Slot 2 IP Address = Slot 3 IP Address = Slot 4 IP Address = Slot 5 IP Address = Slot 6 IP Address = Slot 7 IP Address = Slot 8 IP Address = Slot 9 IP Address = Slot 10 IP Address = Slot 11 IP Address = Slot 12 IP Address = Slot 13 IP Address = Slot 14 IP Address = Slot 15 IP Address = Slot 16 IP Address = Slot 17 IP Address = Slot 18 IP Address =

TASK 5: Create a Default Route

On the Static Routes screen, create a default route to the management domain next hop router. This default route will be used when no other routes in the routing table apply.

Access the . . .	By . . .
Static Routes screen	Selecting *Configuration* → *IP Router* → *Static Routes* from the Hotwire – MCC menu.

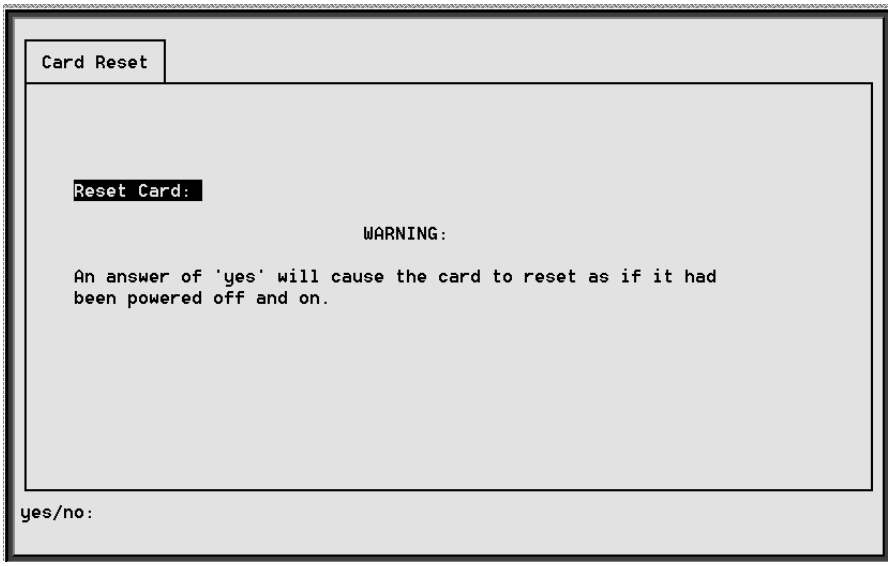


Static Routes Screen	A-E-A
Prompt	**Your Configuration Setting**
1. Enter **0** or press Return at the **Item Number (0 to add new record):** prompt to add a new record.	
2. Enter **0.0.0.0** at the **Destination (or space to delete route):** prompt.	Host/Net = **0.0.0.0**
3. Enter **0.0.0.0** or press **Return at the Subnet:(nnn.nnn.nnn.nnn):** prompt.	Subnet Mask = **0.0.0.0**
4. Enter the management domain next-hop router's IP address at the **Next Hop IP Address (nnn.nnn.nnn.nnn):** prompt.	Next Hop =

Static Routes Screen	**A-E-A**
Prompt	**Your Configuration Setting**
5. Enter **50** at the **`Input Number:`** prompt to specify the preference for this route. 1 has the highest preference. The greater the number the lower the preference.	Pref= 50
6. Enter **dst** or press Return at the **`Source (Src)/ Destination(dst):`** prompt.	S/D= **dst**
7. Enter **no** or press Return at the **`yes/no:`** prompt to keep the NO value under the PA (proxy ARP) column.	PA= **no**
8. When the system highlights **`Save Changes?`**, enter **yes** at the **`yes/no:`** prompt.	

TASK 6: Reset the MCC Card

After configuring the MCC card for the management domain, reset the card to install the configuration setting. On the Card Reset screen (*Configuration → Card Status → Card Reset)*, reset the MCC card by entering **yes** at the **yes/no:** prompt.



NOTE:

After resetting the MCC card, select a DSL card to continue with the management domain configuration. To select a DSL card:

— Press Return to display the top-level menu (Hotwire Chassis menu).

— Select **Card Selection** from the Hotwire Chassis menu.

The Card Selection screen appears.

— Verify that the DSL card you want to configure appears on the Card Status screen.

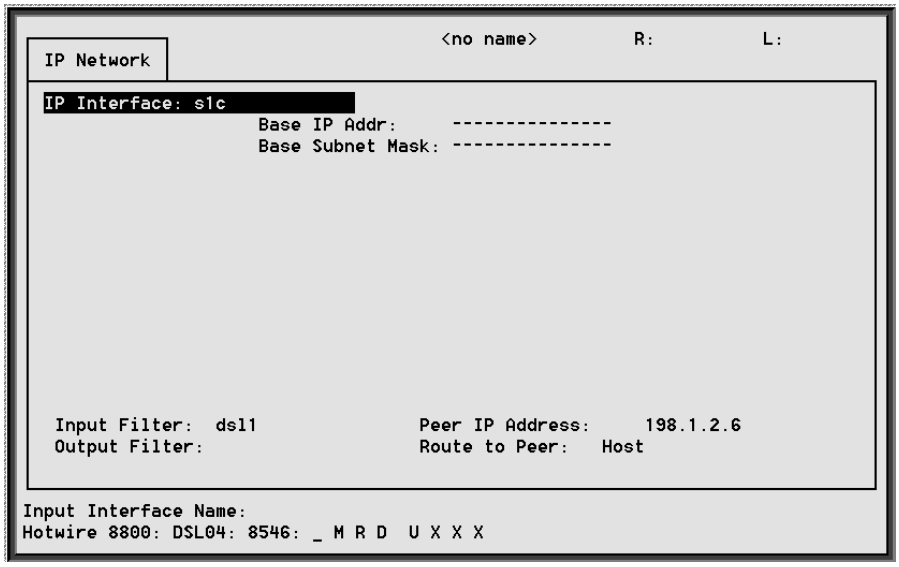
— At the **Goto Card (M for MCC or slot# for DSL):** prompt, enter the number of the slot. Then, press Return. For example, if you want to configure the DSL card in slot 4, enter **4**.

The Hotwire – DSL menu appears.

TASK 7: (When Using an 8546 DSL Card) Configure the Hotwire 5446 RTU Management Domain IP Addresses

On the IP Network screen, configure the Hotwire 5446 RTU IP addresses on each 8546 DSL card, which are the RTU's management domain IP addresses.

Access the . . .	By . . .
IP Network screen	Selecting *Configuration* → *Interfaces* → *IP Network* from the Hotwire – DSL menu.



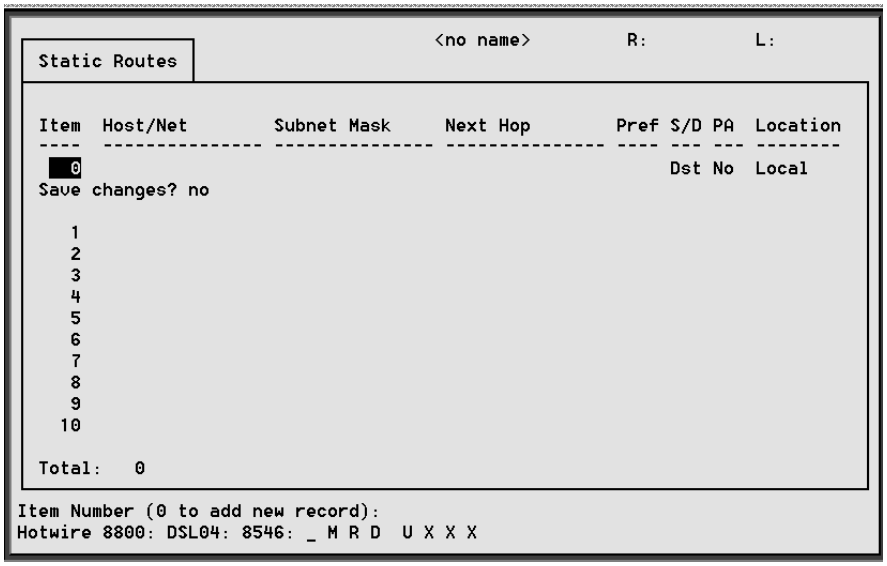
IP Network Screen	A-C-B
Prompt	**Your Configuration Setting**
For DSL port 1 (s1c):	
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **`s1c`**
2. Enter the port 1 5446 RTU's IP address or the IP address of the router connected to the 5546 RTU at the **`(nnn)`** prompt.	Peer IP Address =
3. Enter route type **HOST** at the **`Route to peer (host/net):`** prompt.	Route to Peer= **HOST**

IP Network Screen	A-C-B
Prompt	**Your Configuration Setting**
For DSL port 2 (s1d):	
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **s1d**
2. Enter the port 2 5446 RTU's IP address or the IP address of the router connected to the 5546 RTU at the **`(nnn)`** prompt.	Peer IP Address =
3. Enter route type **HOST** at the **`Route to peer (host/net):`** prompt.	Route to Peer= **HOST**
For DSL port 3 (s1e):	
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **s1e**
2. Enter the port 3 5446 RTU's IP address or the IP address of the router connected to the 5546 RTU at the **`(nnn)`** prompt.	Peer IP Address =
3. Enter route type **HOST** at the **`Route to peer (host/net):`** prompt.	Route to Peer= **HOST**
For DSL port 4 (s1f):	
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **s1f**
2. Enter the port 4 5446 RTU's IP address or the IP address of the router connected to the 5546 RTU at the **`(nnn)`** prompt.	Peer IP Address =
3. Enter route type **HOST** at the **`Route to peer (host/net):`** prompt.	Route to Peer= **HOST**

TASK 8: Create a Static Route to an NMS

On the Static Routes screen, create a static route to the NMS (on each DSL card). Use this screen to enable the management traffic from the 8540 DSL cards, or the 8546 DSL cards and their downstream 5446 RTUs to be routed back through the MCC card.

Access the . . .	**By . . .**
Static Routes screen	Selecting *Configuration* → *IP Router* → *Static Routes* from the Hotwire – DSL menu.



Static Routes Screen	**A-E-A**
Prompt	**Your Configuration Setting**
1. Enter **0** or press Return at the **`Item Number (0 to add new record):`** prompt to add a new record.	
2. Enter the IP address of the NMS at the **`Destination (or space to delete route):`** prompt.	1) Host/Net = 2) Host/Net = 3) Host/Net = 4) Host/Net = 5) Host/Net = 6) Host/Net = 7) Host/Net = 8) Host/Net = 9) Host/Net = 10) Host/Net = 11) Host/Net = 12) Host/Net =
3. Do *one* of the following at the **`Subnet:(nnn.nnn.nnn.nnn):`** prompt: – Enter **255.255.255.255** if you want to create a host route to the IP address specified in Step 2, or – Enter the appropriate subnet mask if you want to enter a network or subnet route.	1) Subnet Mask = 2) Subnet Mask = 3) Subnet Mask = 4) Subnet Mask = 5) Subnet Mask = 6) Subnet Mask = 7) Subnet Mask = 8) Subnet Mask = 9) Subnet Mask = 10) Subnet Mask = 11) Subnet Mask = 12) Subnet Mask =
4. Enter the backplane IP address of the MCC card (s1b) at the **`Next Hop IP Address (nnn.nnn.nnn.nnn):`** prompt.	Next Hop =
5. Enter **50** at the **`Input Number:`** prompt to specify the preference for this route. 1 has the highest preference. The greater the number the lower the preference.	Pref= **50**
Up to 12 Network Management Systems (NMSs) can be specified per DSL card.	

Service Domain Configuration Worksheets

For the service domain, select the DSL card you want to configure, and then configure the following for each of the DSL cards in the Hotwire DSLAM:

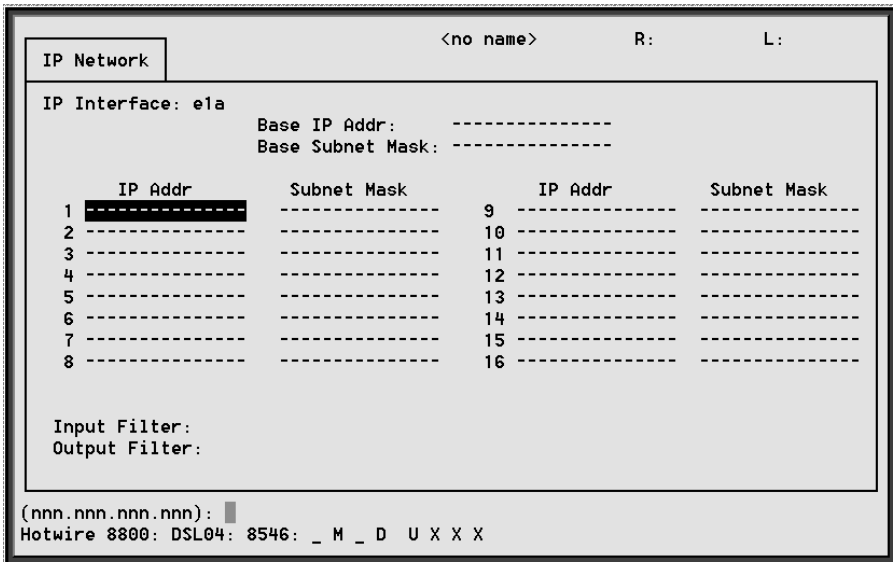
Perform this task . . .	**On this screen . . .**	**To access the screen . . .**
1. Assign IP addresses to the DSL card LAN interface (e1a). (See page A-17.)	(Hotwire – DSL) IP Network	From the Hotwire – DSL menu, select: *Configuration → Interfaces → IP Network*
2. Reset the DSL card. (See page A-19.)	(Hotwire – DSL) Card Reset	From the Hotwire – DSL menu, select: *Configuration → Card Status → Card Reset*
Perform the following tasks only if assigning addresses statically		
3. Create default route or a source route. (See page A-20.)	(Hotwire – DSL) Static Routes	From the Hotwire – DSL menu, select: *Configuration → IP Router → Static Routes*
4. Select RTU type (See page A-22.)	(Hotwire – DSL) RTU	From the Hotwire – DSL menu, select: *Configuration → RTU → Selection*
5. Configure RTU information (See page A-24.)	(Hotwire – DSL) RTU	From the Hotwire – DSL menu, select: *Configuration → RTU → Configuration*
6. Add or remove a static route to the RTU (See page A-26.)	(Hotwire – DSL) RTU	From the Hotwire – DSL menu, select: *Configuration → RTU → Static Routes*
Perform the following task only if assigning addresses dynamically		
7. Define DHCP relay features to enable dynamic IP address configuration. (See page A-28.)	(Hotwire – DSL) DHCP Relay	From the Hotwire – DSL menu, select: *Configuration → DHCP Relay*

Use the worksheets in the following sections to record your network configuration settings. Photocopy the worksheets as needed.

TASK 1: Assign IP Addresses to the DSL Card LAN Interface (e1a)

On the IP Network screen, assign IP addresses to the DSL card LAN interface (e1a). Up to 16 ISP domains can be supported per DSL card.

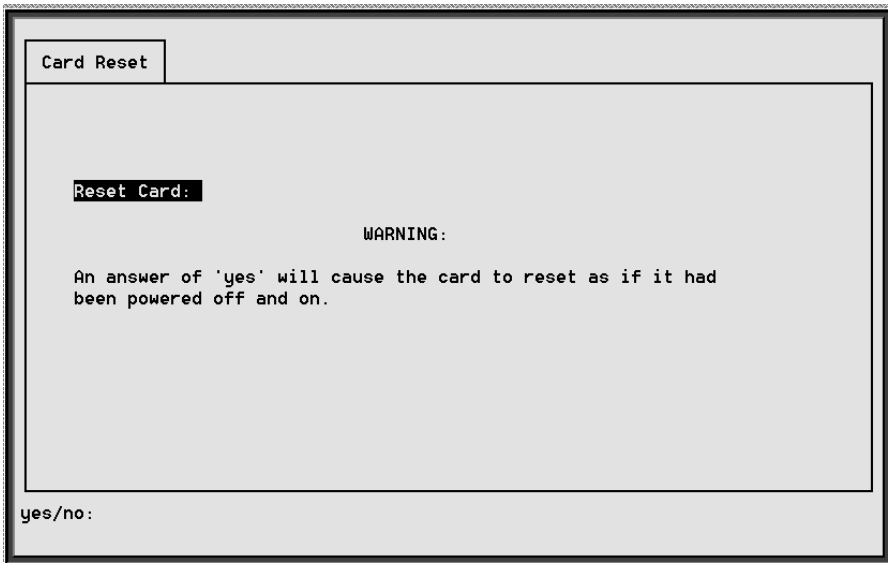
Access the . . .	**By . . .**
IP Network screen	Selecting *Configuration* → *Interfaces* → *IP Network* from the Hotwire – DSL menu.



IP Network Screen	A-C-B
Prompt	**Your Configuration Setting**
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **`e1a`**
2. Enter the IP address at the **`(nnn.nnn.nnn.nnn):`** prompt. This address must be different than the management domain IP address.	1) IP Addr = 2) IP Addr = 3) IP Addr = 4) IP Addr = 5) IP Addr = 6) IP Addr = 7) IP Addr = 8) IP Addr = 9) IP Addr = 10) IP Addr = 11) IP Addr = 12) IP Addr = 13) IP Addr = 14) IP Addr = 15) IP Addr = 16) IP Addr =
3. Enter the subnet mask at the **`(nnn.nnn.nnn.nnn):`** prompt.	1) Subnet Mask = 2) Subnet Mask = 3) Subnet Mask = 4) Subnet Mask = 5) Subnet Mask = 6) Subnet Mask = 7) Subnet Mask = 8) Subnet Mask = 9) Subnet Mask = 10) Subnet Mask = 11) Subnet Mask = 12) Subnet Mask = 13) Subnet Mask = 14) Subnet Mask = 15) Subnet Mask = 16) Subnet Mask =
Up to 16 IP addresses and subnet masks can be entered. Enter the IP addresses and subnet masks for each ISP domain supported by the specified DSL card.	

TASK 2: Reset the DSL Card

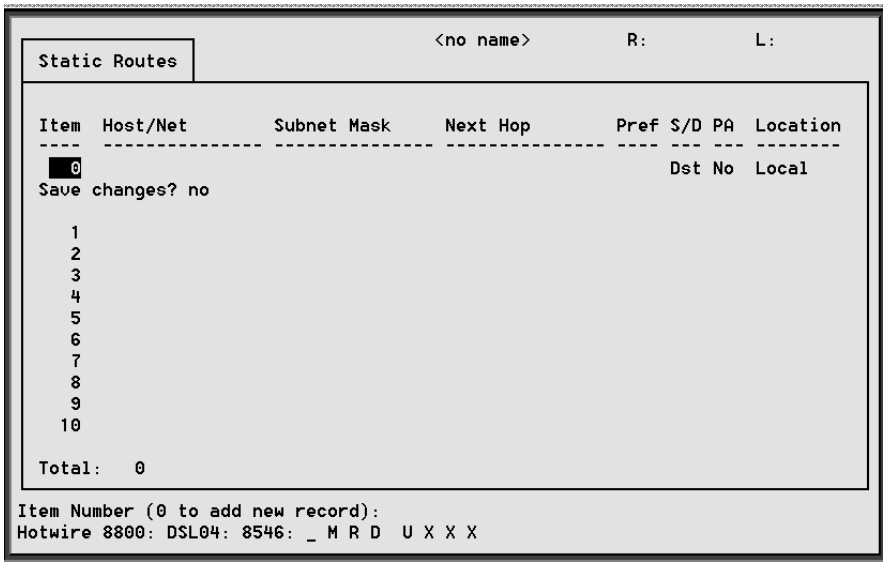
After configuring the e1a interface, reset the card. On the Card Reset screen (*Configuration → Card Status → Card Reset)*, reset the DSL card by entering **yes** at the **`yes/no:`** prompt.



TASK 3: Create a Default Route or Source Route

On the Static Routes screen, create a default route or source route for each DSL card (upstream direction). If creating a default route, fill out one worksheet. If creating source routing, complete one worksheet per domain (up to 16 domains; four domains per port).

Access the . . .	By . . .
Static Routes screen	Selecting *Configuration* → *IP Router* → *Static Routes* from the Hotwire – DSL menu.



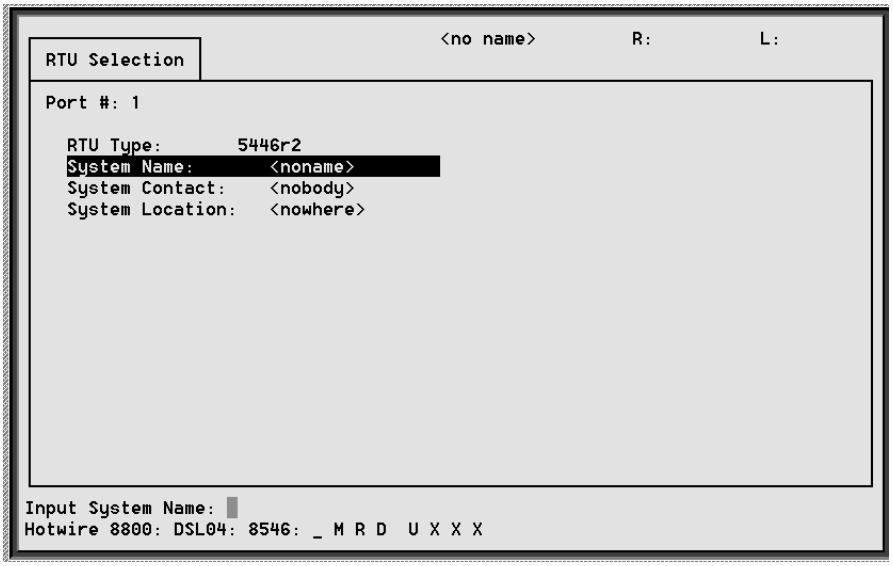
Static Routes Screen	A-E-A
Prompt	**Your Configuration Setting**
1. Enter **0** or press Return at the **`Item Number (0 to add new record):`** prompt to add a new record.	
2. Do *one* of the following: – To create a default route, enter **0.0.0.0** at the **`Destination (or space to delete route):`** prompt, or – To create a source route, enter the source route address at the **`Destination (or space to delete route):`** prompt.	Host/Net =

Static Routes Screen	**A-E-A**
Prompt	**Your Configuration Setting**
3. Do *one* of the following: – To create a default route, enter **0.0.0.0** at the **`Subnet: (nnn.nnn.nnn.nnn):`** prompt**,** or – To create a source route, enter a host or subnet mask at the **`Subnet:(nnn.nnn.nnn.nnn):`** prompt.	Subnet Mask =
4. Enter the IP address of the next hop at the **`Next Hop IP Address (nnn.nnn.nnn.nnn):`** prompt.	Next Hop =
5. Enter a number at the **`Input Number:`** prompt to specify the measurement of preference for this route over other routes for the same destination. 1 has the highest preference. The greater the number the lower the preference.	Pref=
6. Enter **dst** or **src** at the **`Source (Src)/ Destination(dst):`** prompt. (Not for default routes.)	S/D=
7. Enter **no** or press Return at the **`yes/no:`** prompt to keep the NO value under the PA (proxy ARP) column. (Not for default routes.)	PA= **no**
8. When the system highlights **`Save Changes?`**, enter **yes** at the **`yes/no:`** prompt.	

TASK 4: Select RTU Type

On the RTU Selection screen, select the RTU type.

Access the . . .	By . . .
Selection screen	Selecting *Configuration* → *RTU* → *Selection* from the Hotwire – DSL menu.



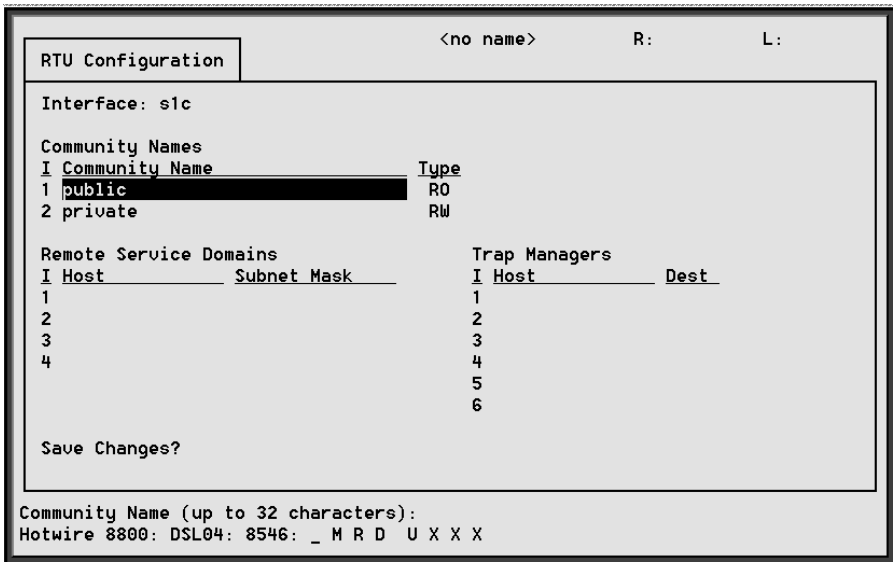
RTU Selection Screen	A-H-A
Prompt	**Your Configuration Setting**
1. Enter **1 to 4** at the **`Port #`** prompt.	Port number =
2. Enter the RTU type of the endpoint. For Model 8540, selections are 5170, 5171, 5246, or 5216. For Model 8546, selections are 5446r1, 5446r2, or 5546. The default is 5446r2.	For Model 8540: RTU type = For Model 8546: RTU type = Default is 5446r2.
3. Enter the RTU system name at the **`System Name`** prompt.	System name =
4. Enter the RTU system contact at the **`System Contact`** prompt.	System contact =
5. Enter the RTU system location at the **`System Location`** prompt.	System location =

RTU Selection Screen	A-H-A
Prompt	**Your Configuration Setting**
6. Model number, serial number, firmware revision, hardware revision, and CAP release fields will appear. These fields are read only.	
7. When the system highlights **Save Changes?**, enter **yes** at the **yes/no:** prompt.	

TASK 5: Configure RTU Information

On the RTU Information screen, configure RTU information only if the RTU type is 5446r1 or 5446r2..

Access the . . .	By . . .
Configuration screen	Selecting *Configuration* → *RTU* → *Configuration* from the Hotwire – DSL menu.



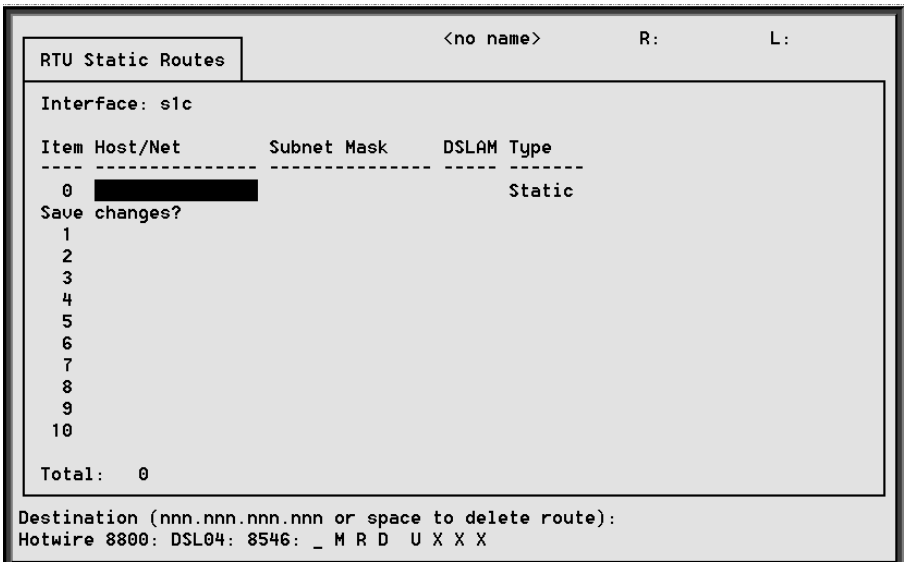
RTU Configuration Screen	A-H-B
Prompt	**Your Configuration Setting**
1. Enter the interface name at the **DSL Interface Name (s1a, s1d, s1e, or s1f):** prompt.	Interface name =
2. Enter the community name at the **Community Name (up to 32 characters):** prompt.	Community name =
3. Enter the Remote Service Domain Host at the **IP Host Address (nnn.nnn.nnn.nnn or space to delete):** prompt.	Remote Serve Domain IP Host Address =
4. Enter the Subnet Mask at the **Network Subnet Mask (nnn.nnn.nnn.nnn)** prompt.	Subnet Mask =
5. Enter the Trap Manager IP Host at the **IP Host Address (nnn.nnn.nnn.nnn or space to delete):** prompt.	Trap Manager IP Host Address=

RTU Configuration Screen	A-H-B
Prompt	**Your Configuration Setting**
6. Enter the Destination Interface name at the **`Destination Interface: (DSL/Ether):`** prompt.	Destination Interface Name =
7. When the system highlights **`Save Changes?`**, enter **`yes`** at the **`yes/no:`** prompt.	

TASK 6: Add or remove a static route to the RTU

On the RTU Static Routes screen, add and remove static routes to the RTU.

Access the . . .	By . . .
Configuration screen	Selecting *Configuration* → *RTU* → *Static Routes* from the Hotwire – DSL menu.



RTU Static Routes Screen	A-H-C
Prompt	**Your Configuration Setting**
1. Enter the interface name at the **`DSL Interface Name (s1a, s1d, s1e, or s1f):`** prompt.	Interface name =
2. Enter the Host/Net address at the **`Destination (nnn.nnn.nnn.nnn or space to delete route):`** prompt.	Host/Net Address =
3. Enter the Subnet Mask at the **`Subnet Mask (nnn.nnn.nnn.nnn)`** prompt.	Subnet Mask =

RTU Static Routes Screen	A-H-C
Prompt	**Your Configuration Setting**
4. Do one of the following at the at the **DSLAM yes/no:** prompt. – Enter **yes** to automatically create the corresponding DSLAM route for the end system. – Enter **no** to not automatically create the corresponding DSLAM route for the end-system.	DSLAM = Yes
5. When the system highlights **Save Changes?**, enter **yes** at the **yes/no:** prompt.	

NOTE:

When the 8546 card is upgraded to the latest software that supports the **A-H-B** and **A-H-C** screens, the card will automatically retrieve the RTU configuration from the 5446 RTU, provided that the 5446 RTU has first been upgraded to the latest software.

If the 8546 card is upgraded prior to the upgrade of the 5446 RTU endpoints, then the **A-H-B** and **A-H-C** screens (for those DSL ports), are not applicable. However, the 8546 card will automatically retrieve the RTU configuration information upon upgrading the 5446 RTU to the latest software.

CAUTION:

For the latest revision 5446 RTU, the RTU configuration cannot be modified by an external SNMP Manager or the Paradyne IP Injection tool. Also, the RTU configuration of older revision 5446 RTU endpoints should not be modified by an SNMP Manager or the Paradyne IP Injection tool. If modified, the 8546 card may not be able to automatically retrieve the RTU configuration information upon upgrading the 5446 RTU to the latest software.

TASK 7: Define DHCP Relay Features to Enable Dynamic IP Address Configuration

NOTE:

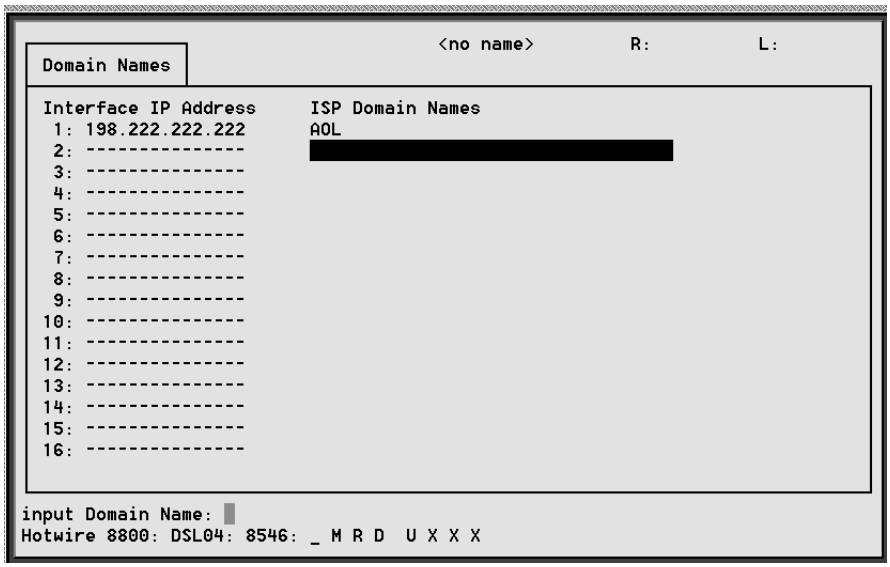
Perform this task only if you are planning to have IP addresses assigned to the end-user systems dynamically by a DHCP server. If you are assigning addresses statically, make sure you have completed the worksheets for *Task 3: Create a Default or Source Route*.

On the Domain Names screen, assign a domain name to each service domain IP address.

On the DHCP Relay 1-4, 5-8, 9-12, or 13-16 screen, configure the DHCP relay agent to:

- Insert IP addresses that were assigned via DHCP
- Determine whether or not an authentication must be performed prior to passing the DHCP request
- Determine whether or not you want to create filters automatically
- Select default domains

Access the . . .	**By . . .**
The IP Network screen Make sure that the Next Hop Address used in relaying DHCP requests is configured as an *e1a* address on the IP Network screen.	*Configuration→Interfaces→IP Network* (**A-C-B**) from the Hotwire – DSL Menu.
To determine which DHCP Relay Server screen to use, access the Domain Names screen. From that screen, search for the NSP domain name you want to configure for dynamic IP addressing. For example, if the domain name is number 4 on the list, then you will need to go to the Servers 1-4 screen to configure that NSP domain name. Enter the NSP Domain Name that you want to associate with the gateway address, and press Return. Press Ctrl-z and confirm the save.	Select *Configuration→DHCP Relay→Domain Names* (**A-G-A**)
Select DHCP Relay (Servers 1-4, Servers 5-8, Servers 9-12, or Servers 13-16) screen **NOTE:** The DHCP Relay Servers 1-4 screen is used for configuring the first four NSP domain names. The DHCP Relay Servers 5-8 screen is used for configuring the next four NSP domain names, etc.	Selecting *Configuration → DHCP Relay → Servers 1-4 , Servers 5-8, Servers 9-12, or Servers 13-16* from the Hotwire – DSL menu.



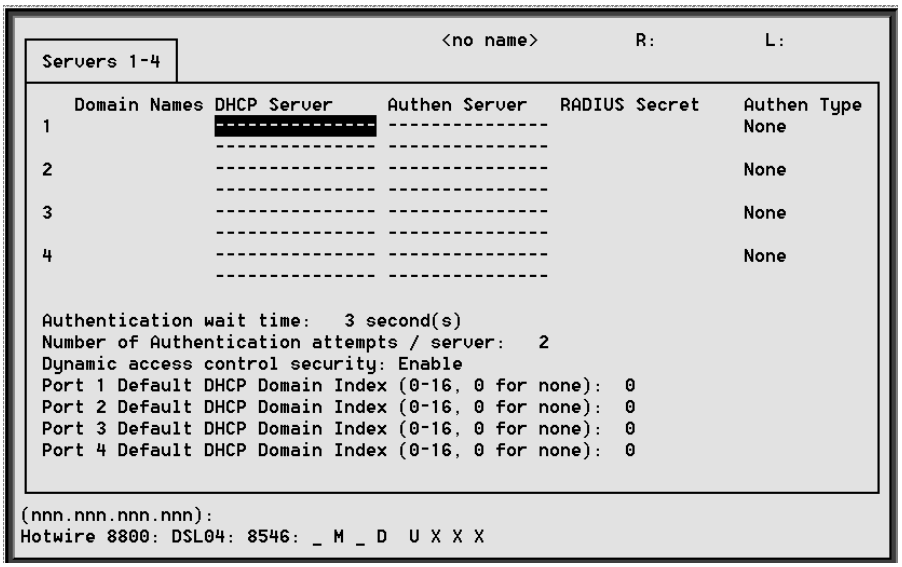
You will need to assign a set of domain names that correspond with the already configured Ethernet IP addresses (e1a interface) for the service domains on the Domain Names screen.

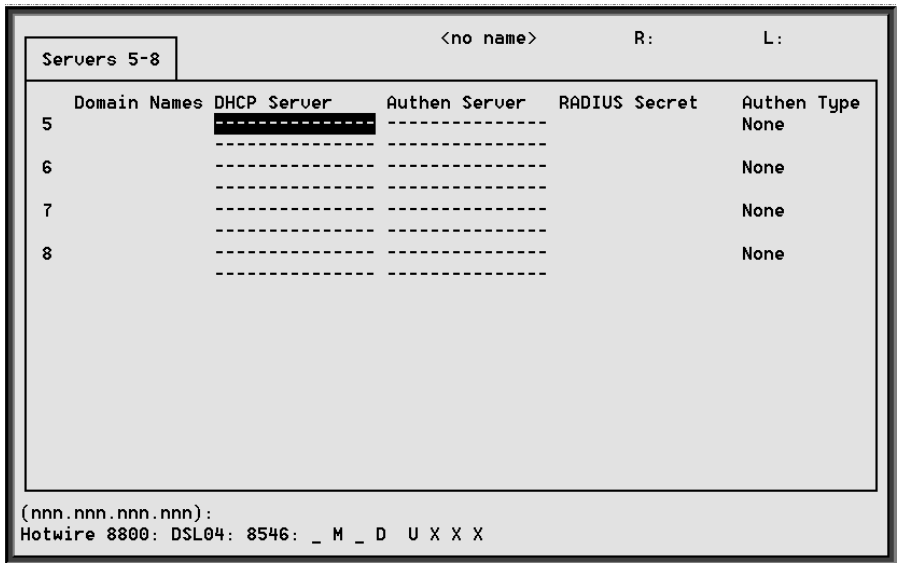
The domain names are numbered 1 through 16 in the order in which they are entered on this screen. Search for the domain name you want to configure for dynamic IP addressing. Remember the number (1–16) for the specific domain name you want to configure. You will need to configure the DHCP relay agent for the domain name on the appropriate Servers screen (Servers 1-4, Servers 5-8, Severs 9-12, or Servers 13-16). For example, if you want to configure the fourth domain name on the Domain Names screen, then you will need to configure that domain on the Servers 1-4 screen.

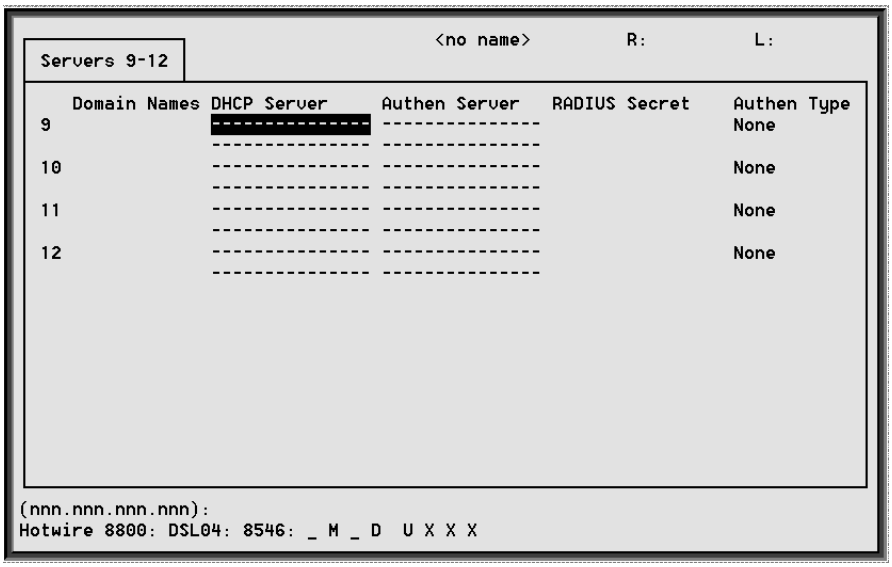
NOTE:

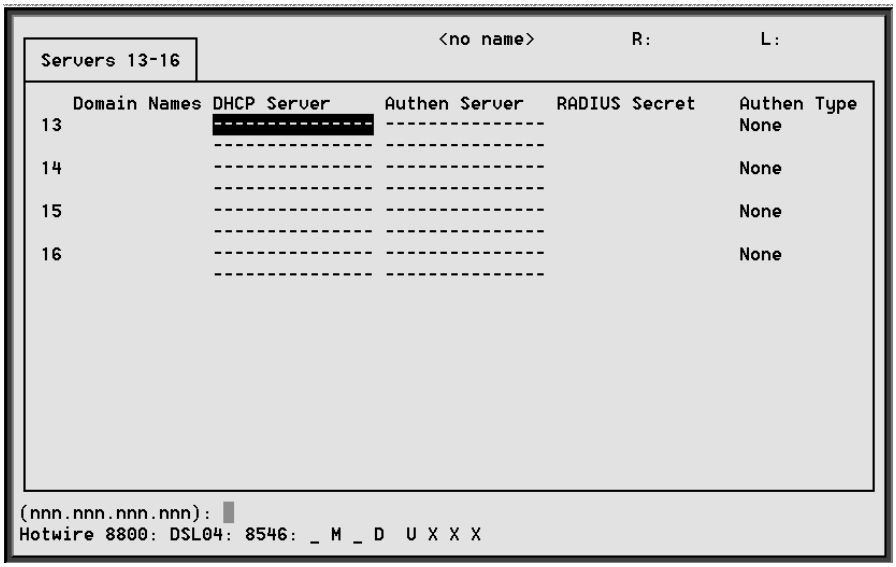
The full domain name will be displayed at the bottom of the page if the character “n” is entered in any of the associated IP address fields.

In addition, for each port that has a DHCP end user, you should configure a default domain in the **`Default DHCP Domain Index`** field. In this field, enter the number associated with a configured DHCP server that you want to specify as the default domain.


<no name> R: L:
Servers 1-4
Domain Names DHCP Server Authen Server RADIUS Secret Authen Type
1 None
2 None
3 None
4 None
Authentication wait time: 3 second(s)
Number of Authentication attempts / server: 2
Dynamic access control security: Enable
Port 1 Default DHCP Domain Index (0-16, 0 for none): 0
Port 2 Default DHCP Domain Index (0-16, 0 for none): 0
Port 3 Default DHCP Domain Index (0-16, 0 for none): 0
Port 4 Default DHCP Domain Index (0-16, 0 for none): 0
(nnn.nnn.nnn.nnn):
Hotwire 8800: DSL04: 8546: _ M _ D U X X X


<no name> R: L:
Servers 5-8
Domain Names DHCP Server Authen Server RADIUS Secret Authen Type
5 None
6 None
7 None
8 None
(nnn.nnn.nnn.nnn):
Hotwire 8800: DSL04: 8546: _ M _ D U X X X


<no name> R: L:
Servers 9-12
Domain Names DHCP Server Authen Server RADIUS Secret Authen Type
9 None
10 None
11 None
12 None
(nnn.nnn.nnn.nnn):
Hotwire 8800: DSL04: 8546: _ M _ D U X X X


<no name> R: L:
Servers 13-16
Domain Names DHCP Server Authen Server RADIUS Secret Authen Type
13 None
14 None
15 None
16 None
(nnn.nnn.nnn.nnn):
Hotwire 8800: DSL04: 8546: _ M _ D U X X X

Servers 1- 4, 5-8, 9-12, and 13-16 screens	**A-G-B, A-G-C, A-G-D, or A-G-E**
Prompt	**Your Configuration Setting**
1. Enter the IP addresses **(nnn.nnn.nnn.nnn)** of the DHCP servers for this domain. **NOTE:** If you do not enter a value in these fields (i.e., the field is null), then all DHCP requests (with domain name information) from this NSP domain's end users will be dropped.	DHCP Server =
2. (Optional) Enter the IP addresses **(nnn.nnn.nnn.nnn)** of the Authentication servers for this domain if you want to confirm the location of the end users before forwarding the message to the DHCP server. *This step is required if RADIUS or XTACACS is specified.*	Authen Server =
3. (Optional) If you are using the RADIUS authentication type, you must fill in this field. The RADIUS secret is the key used to encrypt the RADIUS message sent to the server. This field accepts up to 16 characters.	RADIUS Secret =
4. Do *one* of the following to specify the authentication type: – Enter **N** (None) if you do not want to perform an authentication, or – Enter **R** (RADIUS) if you want to forward the message to a RADIUS server to confirm the location of the end user before sending the message to the DHCP server, or – Enter **T** (XTACACS) if you want to forward the message to a XTACACS server to confirm the location of the end user before forwarding the message to the DHCP server. **NOTE:** Passwords configured on the authentication servers must not be configured with an expiration date. Make sure the appropriate administrators are notified.	Authen Type =
5. (Optional) Enter the length of time (in seconds) that the system waits for a response before timing out. (Default value is 3 seconds.)	Authentication wait time=
6. (Optional) Enter the number of attempts to the authentication server. (Default value is 2 attempts.)	Number of Authentication attempts =

Servers 1- 4, 5-8, 9-12, and 13-16 screens	A-G-B, A-G-C, A-G-D, or A-G-E
Prompt	**Your Configuration Setting**
7. (Optional) Enter **E** (enable) or **D** (disable) to turn on or turn off dynamic access control security. **NOTE:** If you choose to enable this feature, the system will automatically create filters that will validate end users accessing the NSP network.	Dynamic access control security =
8. Specify the default domain by entering the number associated with the domain name on the screen, or enter **0** if you do not want to specify a default domain. **NOTE:** If the end-user system sends a DHCP request that does not contain the domain name information in the message, then the DHCP request will go to the designated default domain server as specified in this field.	Port 1 Default DHCP Domain Index = Port 2 Default DHCP Domain Index = Port 3 Default DHCP Domain Index = Port 4 Default DHCP Domain Index =

IP Filtering Configuration Worksheets

B

Overview

This appendix provides worksheets to assist you in creating filters for your Hotwire DSLAM network. Use the worksheets to record filter parameters such as IP filter types and rule types for the MCC card and DSL cards. Photocopy the worksheets as needed. After the worksheets are completed, define the filters and rule types via the Hotwire DSLAM user interface.

The worksheets are based on the network model and IP filtering theory described in this guide. For an explanation of the network model and IP filtering theory, review the chapters in this guide. For specific information about the user interface screens and fields, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Summarizing How to Define a Filter

To define a filter for a specific interface to indicate whether a packet can be forwarded or discarded on that interface:

- Go to the appropriate IP Filter Configuration screen to define a filter and set up one or more rule types (network address rule type, host address rule type, and/or socket address rule type) for that filter.
- Go to the appropriate IP Network screen to bind the filter (i.e., specify the filter type (input filter or output filter) by specifying the name of the filter in the appropriate field and binding it to a specific interface).

NOTE:

If your system is set up for dynamic IP addressing and you have enabled the dynamic access control feature (on the DHCP Relay Servers screen), you do not need to define filters because this is done automatically. Make sure, however, that the predefined filters are bound to their appropriate interfaces.

NOTE:

In this release, you can configure up to two filters on the MCC card and up to eight filters on each DSL card. Also, up to 33 rules can be configured for each filter. Keep in mind that for each filter, you will need to configure the default filter action (either to forward or discard packets).

For each DSL card, the Hotwire DSLAM provides the following default filter names:

- **lan1** – bound to e1a
- **dsl1** – bound to DSL port #1
- **dsl2** – bound to DSL port #2
- **dsl3** – bound to DSL port #3
- **dsl4** – bound to DSL port #4

For the MCC card, **lan1** (bound to e1a) is the only default filter.

When using these filter names as input filters, by default, these filters are already bound to their corresponding interfaces. To use these filter names as output filters, you must manually bind them on the IP Network screen.

Filtering Configuration Worksheets

The following sections provide worksheets for configuring filters. Use these worksheets when creating filters on the MCC or DSL cards.

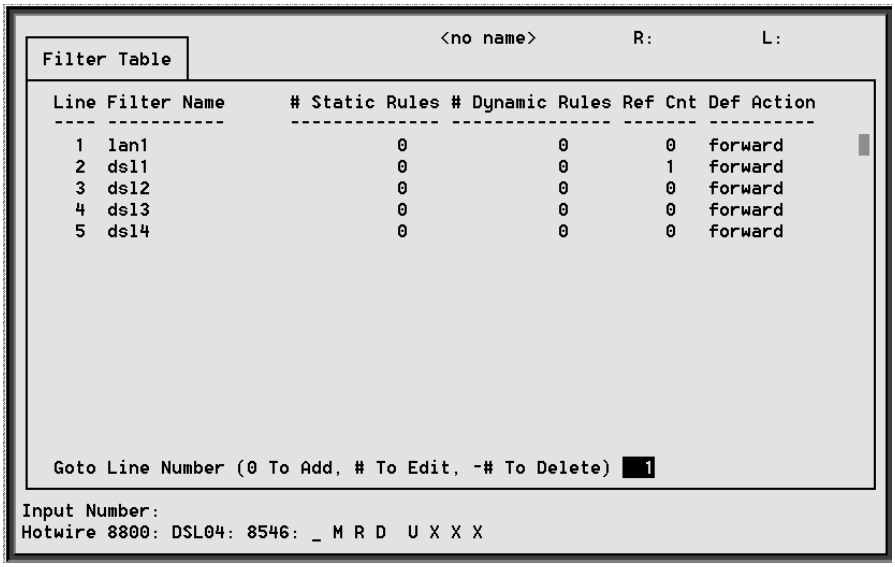
Defining the Filter and Rules

On the IP Filter Configuration screen, create a filter and define its rules. Complete one worksheet for each rule.

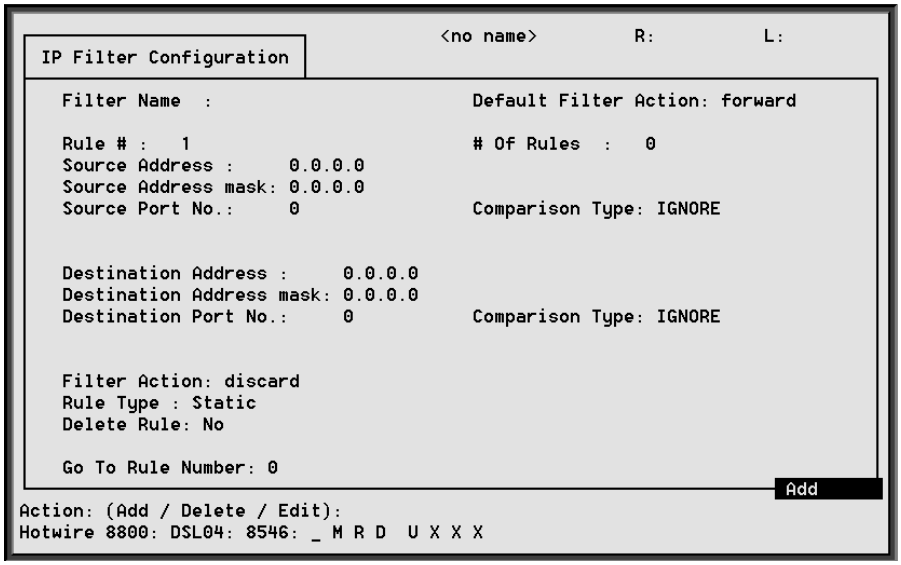
NOTE:

In this release, up to 33 rules can be configured for each filter. If you do not specify rules, the system will forward or discard packets based on the value you set for the default filter action (on the `Def Action` field). By default, the value of this field is set to forward.

Access the . . .	**By . . .**
Filter Table screen	Selecting *Configuration* → *IP Router* → *IP Router Filters* from the appropriate menu (Hotwire – MCC menu or the Hotwire – DSL menu).



Access the . . .	By . . .
IP Filter Configuration screen	Entering the line number of the desired filter name on the Filters Table screen (see page B-3).



IP Filter Configuration	A-E-C
Prompt	**Your Configuration Setting**
1. At the **Action: (Add/Delete/Edit):** prompt, type **A** to add a rule.	
2. At the discard/forward: prompt, type the desired filter action.	Default Filter Action =

IP Filter Configuration	A-E-C
Prompt	**Your Configuration Setting**
3. Enter the name of the filter for which you want to define rules at the **`Enter Filter Name:`** prompt. The DSLAM provides the following filter names that are already bound to the appropriate interface: – For the e1a interface, enter **lan1**. – For the DSL port #1 interface, enter **dsl1**. – For the DSL port #2 interface, enter **dsl2**. – For the DSL port #3 interface, enter **dsl3**. – For the DSL port #4 interface, enter **dsl4**. **NOTE:** You cannot delete these default filter names from the system. However, you can specify another filter by overwriting the existing filter name with the name of the filter you want to use. If you change the filter on this screen, you must remember to change the name specified in the **`Input Filter`** field on the IP Network screen. If you use the default filter name, you do not need to go to the IP Network screen, because the default filter names are already bound to the appropriate interface.	Filter Name =

IP Filter Configuration	A-E-C
Prompt	**Your Configuration Setting**
4. Depending on the rule type (or combination of rule types) you want to define, do one or more of the following: – To define a *network address rule type*, specify either an IP address or subnet mask in the **`Source Address`** and **`Source Address mask`** fields, or the **`Destination Address`** and **`Destination Address mask`** fields. – To define a *host address rule type*, specify either an IP address or subnet mask in the **`Source Address`** and **`Source Address mask`** fields, or the **`Destination Address`** and **`Destination Address mask`** fields. – To define a *socket address rule type*, specify the source (socket) port number at the **`Source Port No.`** field and the destination (socket) port number at the **`Destination Port No.`** field. This rule type may be used in conjunction with a network address or host address rule type. **NOTE:** Host address rules have precedence over network address rules. All host address rules will be invoked sequentially before the first network address rule. If defining a socket address rule type, you must also specify the comparison type you want to perform in the Comparison Type field. Enter **IGNORE** if you do not want to do a comparison, or one of the following to do a comparison on the port number specified in the packet and the rule: **EQ** (equal to), **NEQ** (not equal to), **GT** (greater than), **LT** (less than), **IN_RANGE** (within the specified range), **OUT_RANGE** (outside of the specified range). For a description of these rule types, see Chapter 7, *IP Filtering*.	**Rule #** ____ Source Address = Source Address mask = Source Port No. = Comparison Type = Destination Address = Destination Address mask = Destination Port No. = Comparison Type =
5. Enter **forward** at the **`Filter Action:`** prompt to activate filtering for the specified filter name, or **discard** to prevent packets that match the rule(s) from passing through.	Filter Action =

Binding the Filter

On the IP Network screen, indicate whether you want to use the filter you have just defined on the IP Filter Configuration screen as an input filter or an output filter for a specific interface on the MCC or DSL card.

NOTE:

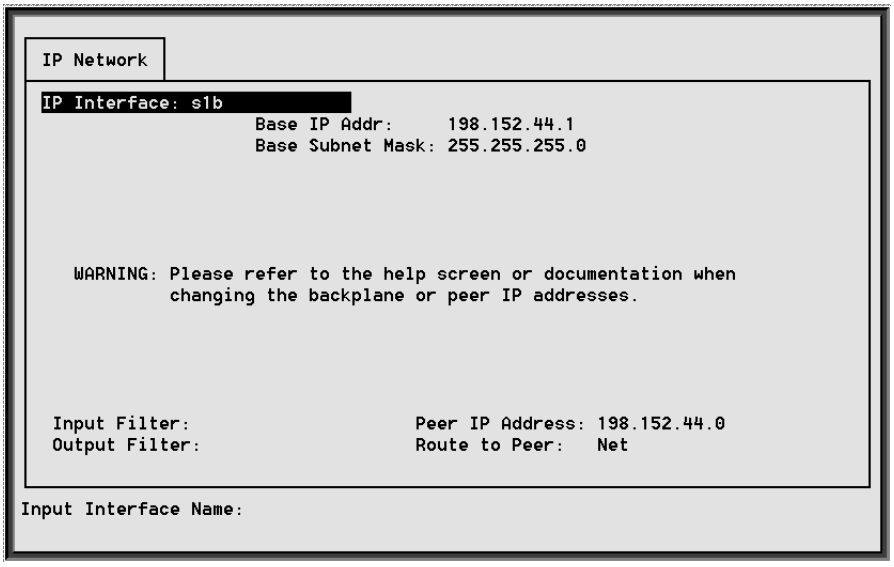
When using the default input filter names, you do not need to complete a worksheet. The default filter names are already bound to their corresponding interfaces, and no further action needs to be done.

However, you will need to complete the following worksheet if you:

— Changed the default input filter name(s) on the IP Filter Configuration screen, or

— Defined an output filter and that filter needs to be bound to a specific interface.

Access the . . .	By . . .
IP Network screen	Selecting *Configuration* → *Interfaces* → *IP Network* from the appropriate menu (Hotwire – MCC menu or the Hotwire – DSL menu).



IP Network Screen	A-C-B
Prompt	**Your Configuration Setting**
1. Enter the interface name at the **`Input Interface Name:`** prompt.	IP Interface = **`s1b`**
2. Enter *one* of the following: – For the Input Filter field, enter the desired filter name at the **`Filter Name (blank to disable filtering):`** prompt. Use an input filter to prevent packets entering the DSL card through a specified interface from being forwarded. – For the Output Filter field, enter the desired filter name at the **`Filter Name (blank to disable filtering):`** prompt. Use an output filter to prevent packets from going out of the DSL card through a specified interface.	Input Filter = or Output Filter = **NOTE:** Remember, if you are using the default filter names as input filters, the filters are already bound to their corresponding interface.

SNMP Configuration Worksheets

C

Overview

This appendix provides worksheets to assist you in setting up general SNMP configurations for your Hotwire DSLAM network, such as defining communities, enabling traps, and preventing unauthorized access to the DSLAM. Use the worksheets (when configuring both MCC and DSL cards) to record SNMP configuration parameters such as community names and IP addresses for associated SNMP NMS managers for a specific card. After the worksheets are completed, configure the SNMP agent via the Hotwire DSLAM user interface.

The worksheets are based on the network model and SNMP agent configuration theory described in this guide. For an explanation of the network model and SNMP agent configuration theory, review Chapter 4, *Components of the Network Model*, and Chapter 8, *SNMP Agent*. For specific information about the user interface screens and fields, see the *Hotwire DSLAM for 8540 and 8546 DSL Cards User's Guide*.

Summarizing the General SNMP Agent Configuration

In summary, to configure the SNMP agent:

- On the SNMP Communities/Traps screen, do the following:
  - — Assign an SNMP NMS manager to a community by specifying the SNMP NMS manager's IP address to a community name.
  - — Configure the generation of all trap messages (except for the Authentication Failure Trap messages, which can be enabled or disabled independently).
  - — Enable or disable the generation of Authentication Failure trap messages.
- On the SNMP Security screen, you can enter the IP addresses of specific, approved SNMP NMS managers to prevent other managers from browsing the Hotwire DSLAM network. Use this screen to prevent unauthorized access to the DSLAM.

SNMP Agent Configuration Worksheets

The following sections provide worksheets for configuring the SNMP agent. Use these worksheets when preparing SNMP configuration on both the MCC and DSL cards.

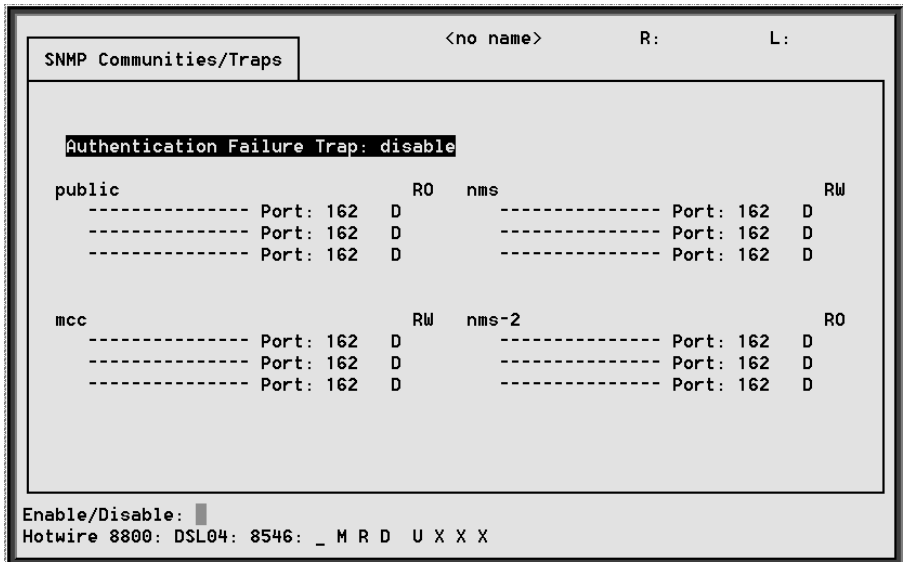
Defining a Community and Enabling Traps

On the SNMP Communities/Traps screen, define a community by specifying the SNMP NMS manager who will receive traps. Up to three managers can be assigned for each community. Also, on this screen, you can enable or disable the generation of traps.

Access the . . .	**By . . .**
SNMP Communities/Traps screen	Selecting *Configuration* → *SNMP* → *Communities/Traps* (**A-F-D**) from the Hotwire – MCC menu if configuring the MCC card. Selecting *Configuration* → *SNMP*→*Communities/Traps* (**A-F-C**) from the Hotwire – DSL menu if configuring a DSL card.

NOTE:

The following screen is the SNMP Communities/Traps screen from the Hotwire – MCC menu. The SNMP Communities/Traps screen from the Hotwire – DSL menu is not shown. However, it displays the same fields and prompts.



SNMP Communities/Traps	
Prompt	**Your Configuration Setting**
1. Determine whether you want to enable or disable Authentication Failure traps: – Enter **enable** at the **`Enable/Disable:`** prompt to forward authentication failure traps to all SNMP NMS managers assigned to a community name. – Enter **disable** at the **`Enable/Disable:`** prompt to prevent the forwarding of authentication failure traps to all SNMP NMS managers assigned to a community name.	Authentication Failure Trap =
2. Change the default community names at the **`Community Name:`** prompt if desired. Hotwire DSLAM provides the following default community names: – **public** (RO – Read Only) – **mcc** (RW – Read Write) – **nms** (RW – Read Write) – **nms - 2** (RO – Read Only) You can also change the access permission for these communities. At the **`ReadOnly (ro)/ReadWrite (rw)/NoAccess (na):`** prompt, specify the desired permission for each community. **NOTE:** Make sure the SNMP NMS manager knows the correct community name. It will need the correct permission to access/browse the Hotwire DSLAM.	Record the Community Names (default or new names) and their access permissions. **public** or _____ Access permission = **mcc** or _____ Access permission = **nms** or _____ Access permission = **nms – 2** or _____ Access permission =

SNMP Communities/Traps	
Prompt	**Your Configuration Setting**
3. For each community name, you can enter IP addresses of up to three SNMP NMS managers. – At the **`(nnn.nnn.nnn.nnn):`** prompt, enter the IP addresses of the SNMP NMS managers. – At the **`Input Number:`** prompt, enter the port number for each SNMP NMS manager specified. All traps will go to the specified port. – At the **`Enable/Disable:`** prompt, indicate whether or not you want to enable or disable the generation of traps. Enter **E** to enable traps. This will forward traps to the specified SNMP NMS manager. Enter **D** to disable traps. This prevents the forwarding of traps.	**public** (RO) or _____: ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = **mcc** (RW) or _____: ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = **nms** (RW) or _____: ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = **nms – 2** (RO) or _____: ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) = ■ IP address = Port = Forward traps (E or D) =

Preventing Unauthorized Access

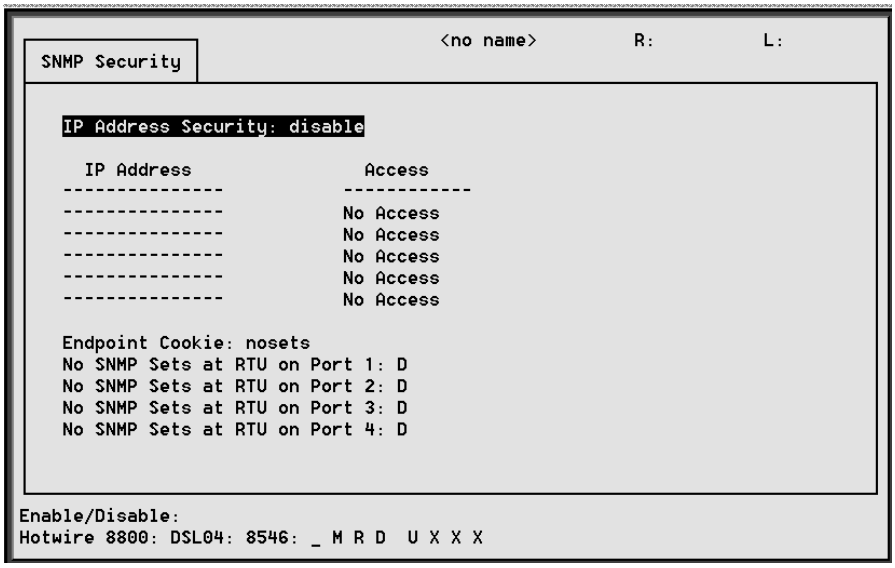
Use the SNMP Security screen to enable SNMP security (i.e., prevent unauthorized managers from browsing or configuring the Hotwire DSLAM network).

- If address security is to be activated, it should be activated on the MCC and all DSL cards.
- If the NSP wants to allow an ISP or customer access to a limited set of DSL cards, that NMS's IP address should only be entered on those DSL cards in the limited set.

Access the . . .	**By . . .**
SNMP Security screen	Selecting *Configuration* → *SNMP* → *Security* (**A-F-A**) from the Hotwire – MCC menu if configuring the MCC card. Selecting *Configuration* → *SNMP* → *Security* (**A-F-A**) from the Hotwire – DSL menu if configuring a DSL card.

NOTE:

The following screen is the SNMP Security screen from the Hotwire – DSL menu. The SNMP Security screen from the Hotwire – MCC menu is not shown. Note, however, the Hotwire – MCC SNMP Security screen does not show the bottom half of the screen (i.e., the RTU security section).



NOTE:

To completely disable SNMP access, do one of the following:

— Set the IP Address Security field to enable and do not enter any IP addresses on the screen, or

— Set the IP Address Security field to enable and make sure that the IP addresses entered on the screen are set to No Access.

SNMP Security	
Prompt	**Your Configuration Setting**
1. Determine whether you want to enable or disable IP address security: – Enter **enable** at the **`Enable/Disable:`** prompt to enable (turn on) security. – Enter **disable** at the **`Enable/Disable:`** prompt to disable (turn off) security.	IP Address Security =
2. At the **`(nnn.nnn.nnn.nnn)`** prompt, enter the IP address of an SNMP NMS manager(s). For each manager, specify the access permission: **NA** (No Access), **RO** (Read Only), or **RW** (Read Write). **NOTE:** You can enter up to five SNMP NMS managers.	■ IP Address = Access = ■ IP Address = Access = ■ IP Address = Access = ■ IP Address = Access = ■ IP Address = Access =
3. At the **`End Point Cookie:`** prompt, enter the security string for host route injection. This is necessary for RTU security. The default value is **nosets**. To disable SNMP sets, make sure you enable SNMP security by specifying E (Enable) for each RTU. **NOTE:** This feature is not applicable and will be ignored for ports connected to the new 5446 RTUs, which always disallow SNMP Sets from the SNMP Manager. The feature is being provided for backward compatibility with older version 5446 RTU units that allow SNMP Sets.	Endpoint Cookie = No SNMP Sets at RTU on Port 1 = No SNMP Sets at RTU on Port 2 = No SNMP Sets at RTU on Port 3 = No SNMP Sets at RTU on Port 4 =

Glossary

10BaseT A 10-Mbps Ethernet LAN that works on twisted-pair wiring.

address A symbol (usually numeric) that identifies the interface attached to a network.

ARP Address Resolution Protocol. Part of the TCP/IP suite, ARP dynamically links an IP address with a physical hardware address.

authentication server An authentication server can either be a RADIUS server or an XTACACS server and can be used to confirm an end-user system's access location.

backplane A common bus at the rear of a nest or chassis that provides communications and power to circuit card slots.

bandwidth The range of frequencies that can be passed by a transmission medium, or the range of electrical frequencies a device is capable of handling.

BootP Bootstrap Protocol. Described in RFCs951 and 1084, it is used for booting diskless nodes.

bps Bits per second. Bits per second. Indicates the speed at which bits are transmitted across a data connection.

byte A sequence of successive bits (usually eight) handled as a unit in data transmission.

CAP Carrierless Amplitude Modulation and Phase Modulation. A transmission technology for implementing a Digital Subscriber Line (DSL). The transmit and receive signals are modulated into two wide-frequency bands using passband modulation techniques.

central office CO. The PSTN facility that houses one or more switches serving local telephone subscribers.

Community name An identification used by an SNMP manager to grant an SNMP server access rights to MIB.

default route The address used for routing packets whose destination is not in the routing table. In Routing Information Protocol (RIP), this is IP address 0.0.0.0.

DHCP Dynamic Host Configuration Protocol. A Microsoft protocol for dynamically allocating IP addresses.

DHCP Relay Agent A system that detects and forwards DHCP discover or request messages to the appropriate DHCP server.

DHCP Server A server which uses DHCP to allocate network addresses and deliver configuration parameters to dynamically configured hosts.

domain A block of IP addresses. Syntactically, all IP addresses within a given domain would share a common IP address prefix of some length.

downstream In the direction of the customer premises.

DSL Digital Subscriber Line. DSL is a copper loop transmission technology enabling high-speed access in the local loop.

DSL card Digital Subscriber Line Card. The primary card in the Hotwire DSLAM system. It has one Ethernet port and four DSL ports.

DSLAM Digital Subscriber Line Access Multiplexer. DSLAM provides simultaneous high-speed digital data access and analog POTS over the same twisted-pair telephone line.

e1a Name of the DSL card's and MCC card's 10BaseT (Ethernet) interface.

Ethernet A type of network that supports high-speed communication among systems. It is a widely-implemented standard for LANs. All hosts are connected to a coaxial cable where they contend for network access using a Carrier Sense, Multiple Access with Collision Detection (CSMA/CD) paradigm.

Ethernet address A six-part hexadecimal number in which a colon separates each part (for example, 8:0:20:1:2f:0). This number identifies the Ethernet communications board installed in a PC and is used to identify the PC as a member of the network.

filter A rule or set of rules applied to a specific interface to indicate whether a packet can be forwarded or discarded.

FTP File Transfer Protocol. A TCP/IP standard protocol that allows a user on one host to access and transfer files to and from another host over a network, provided that the client supplies a login identifier and password to the server.

gateway address The subnet that the end-user system is on.

host A computer attached to a network that shares its information and devices with the rest of the network.

host routes An IP address having a subnet mask of 255.255.255.255.

HDLC High-Level Data Link Control. A communications protocol defined by the International Standards Organization (ISO).

ICMP Internet Control Message Protocol. An Internet protocol that allows for the generation of error messages, test packets, and information messages related to IP.

Internet The worldwide internetwork that predominantly uses the TCP/IP protocol.

intranet A private network or internet using Internet standards and software, but protected from public access.

IP Internet Protocol. An open networking protocol used for internet packet delivery.

IP Address Internet Protocol Address. The address assigned to an Internet host.

ISP Internet Service Provider. A vendor who provides direct access to the Internet.

LAN Local Area Network. A privately owned and administered data communications network limited to a small geographic area.

MAC Media Access Control. The lower of the two sublayers of the data link layer, the MAC sublayer controls access to shared media.

MAC Address Media Access Control Address. The unique fixed address of a piece of hardware, normally set at the time of manufacture, and used in LAN protocols.

margin (DSL) The additional noise, measured in dB, that would need to be added to the existing noise on a given DSL loop to bring the Bit Error Rate to IE–7 (10^7).

MCC Card Management Communications Controller Card. The DSLAM circuit card used to configure and monitor the DSLAM.

MIB Management Information Base. A database of managed objects used by SNMP to provide network management information and device control.

NAP Network Access Provider. The provider of the physical network that permits connection of service subscribers to NSPs.

NMS Network Management System. A computer system used for monitoring and controlling network devices.

NSP	Network Service Provider. A local telephone company or ISP that provides network services to subscribers.
packet	A group of control and data characters that are switched as a unit within a communications network.
PING	An IP-based application used to test reachability of destinations by sending an ICMP echo request and waiting for a reply. The ping program is supported from both the DSL and MCC cards.
POTS	Plain Old Telephone Service. Standard telephone service over the PSTN with an analog bandwidth of less than 4 Hz.
POTS Splitter	A device that filters out the DSL signal and allows the POTS frequencies to pass through.
PPP	Point-to-Point Protocol. as specified by Internet RFC 1661.
proxy ARP	Proxy Address Resolution Protocol (ARP). A technique for using a single IP address for multiple networks. A device responds to ARP requests with its own physical address, then routes packets to the proper recipients.
Router	A device that connects LANs by dynamically routing data according to destination and available routes.
Routing Table	A table used by a node to route traffic to another node in the multiplexer network.
RTU	Remote Termination Unit. A DSL device installed at the customer premises.
s1c	Interface name of a DSL card's DSL port #1.
s1d	Interface name of a DSL card's DSL port #2.
s1e	Interface name of a DSL card's DSL port #3.
s1f	Interface name of a DSL card's DSL port #4.
Service Node	Endpoint modem at the customer premise, also known as a Remote Termination Unit (RTU). There are two model types. See RADSL and MVL.
SNMP	Simple Network Management Protocol. Protocol for open networking management.
SNMP agent	An application level program that facilitates communication between an SNMP management system and a device. See NMS.
SNMP trap	A message sent to an SNMP manager to notify it of an event, such as a device being reset.
static route	A user-specified permanent entry into the routing table that takes precedence over routes chosen by dynamic routing protocols.
subnet address	The subnet portion of an IP address. In a subnetted network, the host portion of an IP address is split into a subnet portion and a host portion using an address (subnet) mask. This allows a site to use a single IP network address for multiple physical networks.
subnet mask	A number that identifies the subnet portion of a network address. The subnet mask is a 32-bit Internet address written in dotted-decimal notation with all the 1s in the network and subnet portions of the address.
TCP	Transmission Control Protocol. An Internet standard transport layer protocol defined in STD 7, RFC 793. It is connection-oriented and stream-oriented.
Telnet	Virtual terminal protocol in the Internet suite of protocols. Allows the user of one host computer to log into a remote host computer and interact as a normal terminal user for that host.

terminal emulation Software that allows a PC to mimic the signals of a specific type of terminal, such as a VT100 or 3270, to communicate with a device requiring that terminal interface.

TFTP Trivial File Transfer Protocol. A standard TCP/IP protocol that allows simple file transfer to and from a remote system without directory or file listing. TFTP is used when FTP is not available.

TraceRoute A program that lists the hosts in the path to a specified destination.

upstream In the direction of the telephone network.

XTACACS See Authentication Server.

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